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CONTRIBUTIONS, ABSTRACTS, AND BIBLIOGRAPHY

WEATHER OF THE MONTH

CHARTS

† In marine separate.

MONTHLY WEATHER REVIEW

Editor, ALFRED J. HENRY Assistant Editor, BURTON M. VARNEY

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AVERAGE PRESSURES FOR OCEANIC AREAS COMPUTED FROM DAILY SYNOPTIC CHARTS

By THOMAS R. REED

[Weather Bureau, San Francisco, Calif.]

The relation of the weather on the North American Continent to the pressure situation over the North Pacific Ocean has long been recognized by meteorologists. The bearing of the position of the subpermanent Aleutian LOW on the movement of the cyclones on the continent has been stressed by Bowie and Weightman, in "Types of Storms in the United States and Their Average Movements," page 4, while the aspect of the North Pacific anticyclone has been variously recognized and discussed. Specific allusion to the influence of the latter is made in a recent issue of the Monthly Weather Review [1] by Blochman, Henry, and McEwen. Henry's reference to the high-pressure phenomenon in the North Pacific as a "statistical anticyclone" is an excellent denomination, since its fixedness in the middle latitudes of the eastern Pacific clearly distinguishes it from the migratory type. Naturally these two complementary wind systems, the HIGH in the south and the LOW in the north, are closely watched by weather forecasters on the Pacific slope, who make a constant study of their movements.

During recent years this practice has been facilitated by the accumulation of observational data by radio from ships traversing the Pacific Ocean, and at the present time reports of this character are normally numerous enough to permit the preparation of fairly complete daily weather charts for the eastern North Pacific Ocean. Much information is therefore being acquired of facts which before were either unrecognized or else only conjectured. For example, it would be natural to suppose that the configuration of isobars delimiting a cyclonic circulation would be much more symmetrical over a large and thermally homogeneous water surface than over continental areas of rugged relief and more or less local contrasts of temperature and humidity. Experience in the day to day preparation of the ocean charts above referred to has not only confirmed this belief, but has demonstrated its applicability to the hitherto somewhat problematical pursuit of information regarding average atmospheric pressure over the oceanic areas in general and also for any desired positions therein. It would be quite impossible to chart the pressure over a land area the size of the United States or even one-tenth of that area from data as scanty as those ordinarily available for a corresponding area of the Pacific Ocean. Yet it seems reasonably certain that the isobaric charts which have been constructed at San Francisco have represented, at least for the last year or more, a fairly accurate delineation of the surface pressure north of the thirtieth parallel and east of the one hundred and eightieth meridian.

It is true that for large parts, especially the central part, of this area data are frequently lacking or altogether absent. In such cases the isobars have been interpolated and the charts completed on the inference that certain observed developments have continued or that a previously observed situation continued to obtain, the pressure gradients being determined under the assumption, as stated above, that the configuration of isobars should normally be to a great extent free from the distortion imposed upon them by artificial or continental conditions. Many times, after this has been done and the charts completed, belated reports have been received from some ships traversing the region for which data had been wanting, and these reports have corroborated the disposition of the isobars already plotted, to a degree which required no material change therein.

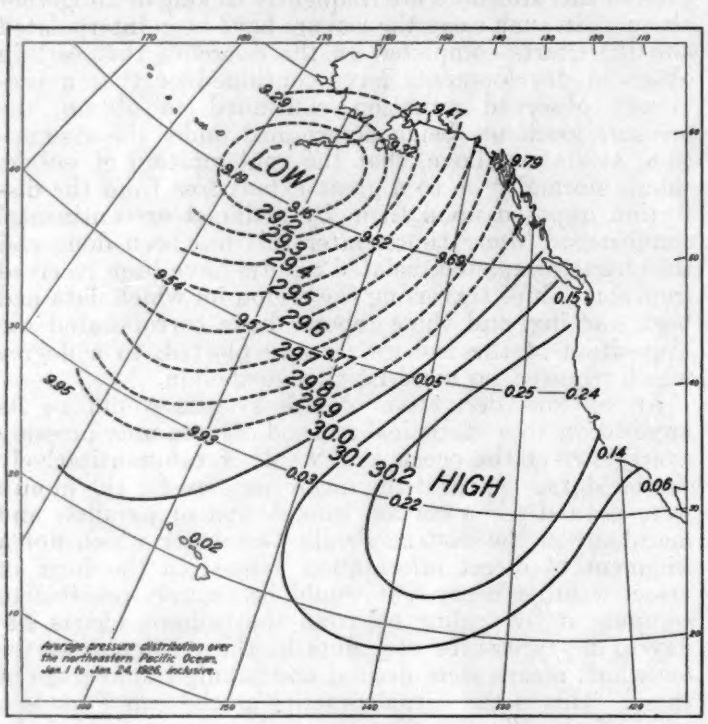
An obvious derivative of this system would be its application to a statistical method of obtaining pressure averages over the ocean as a whole from quantitatively similar data. Thus, if the mean pressure for the month were desired for a certain intersection of parallels and meridians in the eastern Pacific Ocean for which not a fragment of direct information existed in the form of vessel weather reports, it would be entirely possible to compute it by scaling off from the isobaric charts the day-to-day pressures at points in the particular sector for which means were desired and taking the average of these. This is the actual practice at the San Francisco office of the Weather Bureau in the preparation of the daily charts showing pressure variations over the Pacific Ocean; the only difference being that, instead of mean pressure, the object sought is the daily variation in pressure at established points throughout the region affected. This method has been employed for more than a year, and has demonstrated its feasibility for this particular purpose. It has been tested for the purpose of this paper from another angle with interesting and encouraging results, namely, to depict the average position and intensity of the subpermanent low and high pressure areas of the eastern North Pacific Ocean during two consecutive periods when their characteristics as to position, size, and intensity displayed significant and extraordinary contrasts.

The periods selected comprise the respective groups of days from January 1 to 24, 1926, inclusive, and January 25 to February 3, 1926, inclusive. Mean pressures for the ocean area have been computed from daily interpolated values as obtained from the p. m. isobaric charts, computations being made for the intersections of parallels of latitude and meridians of longitude at intervals of 10°. Smaller intervals could have been taken, and are in fact employed for preparation of the daily pressure

[1] Monthly Weather Review, vol. 53, No. 11, pp. 483-494.

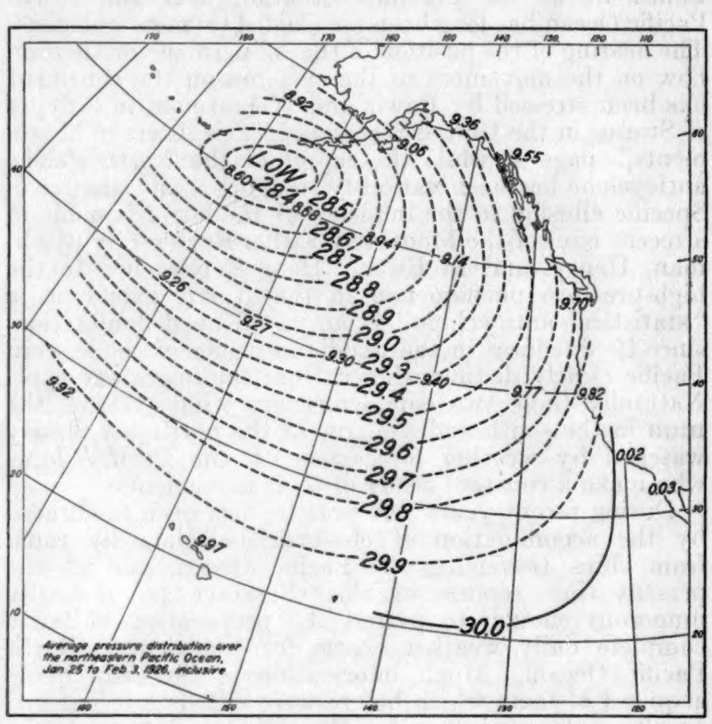
variation charts where it is desired to observe day-to-day fluctuations over small areas; but for obtaining mean values over the ocean as a whole, and for more or less extended periods, data for smaller geographical intervals would serve little purpose, due to the remarkable symmetry of the mean isobaric surfaces. The p. m. charts were chosen for this study as they include data for the Island of Midway, whereas the a. m. charts do not. Mean pressures were therefore available for this station as well as for Honolulu and for coastal stations from the Aleutians to San Diego.

The two charts need little comment; the most casual inspection will reveal conspicuous differences. The first one (fig. 1) comprising the period January 1 to 24, depicts practically normal conditions for January as regards pressure distribution. It conforms strikingly to the well-known mean January pressures as given by the



Average pressure distribution over the northeastern Pacific Ocean, Jan. 1 to Jan. 24, 1926, inclusive.

FIG. 1



Average pressure distribution over the northeastern Pacific Ocean, Jan. 25 to Feb. 3, 1926, inclusive

FIG. 2

Pilot Charts of the Hydrographic Office, the main departures being simply in the somewhat accentuated depth of the Aleutian LOW during the period under review. The relative positions of the HIGH and the LOW, however, approximate the normal, and the directions of their major axes are the usual ones. In Figure 2, which embraces the subsequent period January 25 to February 3, inclusive, the North Pacific HIGH has disappeared entirely, the major axis of the Aleutian LOW has swung through an angle of 90° and lies along a line drawn almost directly through northwest-southeast, while the mean pressure at the center has dropped from 29.20 inches to 28.40 inches.

Naturally such radical alteration in the pressure régime over the ocean could not fail to be reflected by correspondingly contrasted weather conditions on the Pacific slope as between the two periods involved. During the earlier period drought prevailed in California and rain occurred only on two occasions, when it was brief and insufficient, whilst in the Pacific Northwestern States, except for a rainless period from the 6th to the 13th, rain fell with about the usual regularity for the season. In other words, the individual LOWS, bred within the subpermanent low-pressure system to the westward, pursued their normal course along the northerly route, migrating around the northern periphery of the Pacific HIGH and leaving California untouched. Following the disappearance of the Pacific HIGH and the alteration in the direction of the major axis of the Aleutian low-pressure system came a change to wet weather in California. The realignment of the oceanic pressure system was first noticeable on the chart of January 25. It was well confirmed by the chart of January 26, so much so that a statement was incorporated in the official weather synopsis of that date to the effect that general rains would occur in the Pacific States "during the latter part of the current week," viz, January 28 to 30. As a matter of record, rain set in on the northern California coast January 28, covering the entire State with copious precipitation by the 31st, and continuing at intervals as supplied by successive cyclones, until February 5, when a reversion to the ordinary type as depicted in Figure 1, took place, and rains in California ceased.

As the object of this paper is to bring out the possibilities of pressure summaries over oceanic areas from which reports are sporadic and badly distributed, and not to discuss in particular the pecularities of weather resulting from a given pressure distribution, further mention of the stormy period need not be made, beyond remarking that the interval of subnormal rainfall in California which was terminated on January 28, while not perhaps unprecedented, had reached a point which threatened serious economic disasters. The circumstances attendant upon its end are consequently of more than ordinary interest both to the public at large and to the investigator of climatic phenomena.

THE WINDS OF THE MIDDLE AND NORTHERN CALIFORNIA COAST

By ALFRED J. HENRY

In some recent studies of the pressure distribution and the resulting winds of the California coast a few details came to light which seem worthy of preservation in the literature of the climatology of the United States.

Reference is made to the high winds and gales that are experienced in the months April to July, inclusive, along the middle and northern stretch of the California coast.

The studies in question showed that in general the winds of the California coast from the Golden Gate to and perhaps beyond Cape Mendocino have a pronounced seasonal increase in strength, the first in midwinter when land winds sweep down the Coast Range of mountains and out upon the Pacific with velocities which at times approach and indeed exceed 100 miles per hour; the second seasonal increase is in late spring and early summer months when the direction of the wind is exactly the opposite of that which prevails in midwinter, viz, from the ocean to the land.

The strength of these winds in winter depends upon the pressure gradient which obtains for the time being. A deep barometric depression over the ocean approaching the California coast when the Great Basin region is occupied by an anticyclone in which pressures are 30.40 inches and upwards is the occasion for high southeast winds and gales along the coast. Conversely the presence of an extensive trough of low pressure over California with its axis trending north-south in conjunction with an anticyclone over the Pacific, even though the central pressure in it does not exceed 30.10–30.15 inches, provided the surface temperatures in interior California are relatively high, is the occasion for northwest winds and gales over the ocean near the coast and also over the coast range directly to the eastward.

The prevailing winds.—The prevailing wind direction at stations along the California coast, as deduced from twice-daily eye observations, together with the length of the record at each station is set forth in the subjoined table. This table contains also the data for three stations in the interior.

TABLE 1.—*Prevailing winds*

Stations	Length of record years	January	February	March	April	May	June	July	August	September	October	November	December
Roseburg, Oreg.	45	s.	s.	s.	nw.	nw.	nw.	n.	n.-nw.	n.-nw.	nw.	s.	s.
Eureka, Calif.	35	se.	se.	se.	n.	n.	nw.	nw.	nw.	n.	n. se.	se.	se.
Point Reyes, Calif.	35	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.
Southeast Farallon, Calif.	10	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.
Mount Tamalpais, Calif.	21	se.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw	nw.
San Francisco, Calif.	52	n.	w.	w.	w.	w.	w.	w.	sw.	w.	w.	w.	n.
San Diego, Calif.	50	nw.	nw	nw.	nw.	w.	sw nw	nw	nw.	nw.	nw.	nw.	ne.
Valley stations:													
Red Bluff	45	nw.	nw.	nw.	se.	se.	se.	se.	se.	nw.	nw.	nw.	nw.
Sacramento	46	se.	se.	se.	s.	s.	s.	s.	s.	s.	se.	se.	se.
Fresno	35	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.	nw.

The prevailing winds at both Roseburg, Oreg., and Eureka, Calif., are from a southerly or land quarter from November to April, a fact due, in the opinion of the writer, to the very intimate control exercised by the Great Basin anticyclone of the cold months. At the remaining stations along the coast, while the prevailing direction is northerly in the cold months, yet southerly winds prevail for much of the time; in fact, at Point Reyes there are almost as many January and December months with prevailing winds from a southerly quarter as from a northerly quarter. The prevailing winds at San Francisco are largely the result of topographic control. Although the record for Southeast Farallon—a rocky island 28 miles from the entrance to Golden Gate—shows northwest to be the prevailing direction for each month of the year, southerly winds are almost as prevalent in January as northwest.

The coastal winds of the Golden Gate region.—The records used are those of Point Reyes, on the coast, Mount Tamalpais, altitude 2,375 feet, a few miles inland, San Francisco, and Southeast Farallon. The positions of these four stations are shown in the small sketch map, Figure 1.

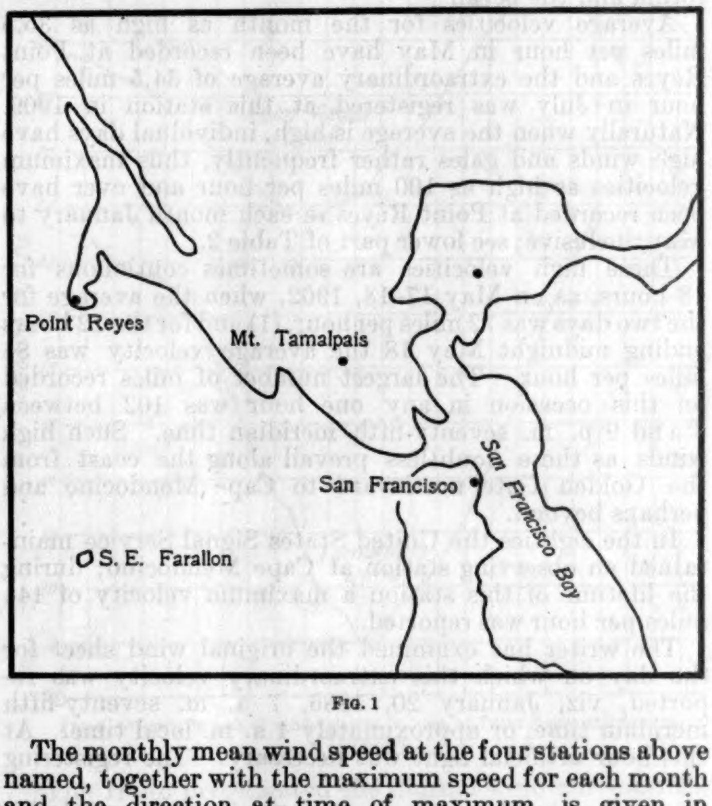


FIG. 1

The monthly mean wind speed at the four stations above named, together with the maximum speed for each month and the direction at time of maximum, is given in Table 2.

TABLE 2.—*Mean monthly wind velocity (mi. p. h.)*

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Point Reyes	17.7	19.5	20.8	23.8	26.1	26.9	22.1	19.8	18.2	17.0	16.6	16.5	20.4
Mt. Tamalpais	19.9	18.3	18.1	18.9	19.5	18.5	15.0	14.2	15.2	16.0	17.6	19.7	17.6
SE. Farallon	15.7	15.3	17.0	17.1	19.1	18.5	15.6	13.9	12.6	12.8	12.9	13.2	15.3
San Francisco	7.4	7.5	8.8	10.1	11.2	12.6	13.1	12.1	10.1	7.8	6.7	6.8	9.5
	Maximum velocities and direction												
Point Reyes	104 nw.	101 nw.	108 sw.	110 nw.	120 nw.	94 nw.	90 nw.	76 nw.	75 nw.	90 nw.	82 se.	96 s.	----
Mt. Tamalpais	90 se.	76 nw.	88 nw.	92 nw.	92 nw.	92 nw.	89 nw.	78 nw.	80 nw.	78 nw.	88 n.	78 sw.	----
SE. Farallon	66 nw.	68 n.	72 se.	60 n.	60 nw.	54 nw.	55 nw.	50 n.	58 nw.	58 nw.	61 nw.	76 s.	----
San Francisco	57 se.	52 s.	60 s.	47 nw.	45 w.	48 sw.	41 w.	42 sw.	42 sw.	44 ne.	64 ne.	60 se.	----
Cape Mendocino.[2]	124 se.	104 se.	92 se.	100 se.	[1] 130	64 se.	56 s.	52 se.	96 se.	82 se.	125 se.	108 se.	----

[1] Estimated. [2] 5 years' record.

It is obvious that the values contained in the above table can not be rigorously correct. If we assume that the record for Southeast Farallon is approximately correct for the water surface, then the values for Point Reyes and Mount Tamalpais should be lowered to offset the increase due to topography, the former by 33 per cent and the latter by 15 per cent, annual averages considered. The San Francisco record due possibly to surface friction and topographic controls should be increased approximately 38 per cent. The figures for Southeast Farallon show a slight decrease January to February, then an increase to May, when the maximum of the year is reached. The increase, January to May, at Southeast Farallon is 3.4 miles, whereas the increase for the same months at Point Reyes is 8.4 miles, more than double that of the first named. This is considered as being due to the great temperature contrast between interior California and the ocean.

Average velocities for the month as high as 35.5 miles per hour in May have been recorded at Point Reyes and the extraordinary average of 34.5 miles per hour in July was registered at this station in 1909. Naturally when the average is high, individual days have high winds and gales rather frequently, thus maximum velocities as high as 100 miles per hour and over have been recorded at Point Reyes in each month January to May, inclusive; see lower part of Table 2.

These high velocities are sometimes continuous for 48 hours, as on May 17–18, 1902, when the average for the two days was 72 miles per hour, (1) and for the 12 hours ending midnight May 18 the average velocity was 84 miles per hour. The largest number of miles recorded on this occasion in any one hour was 102 between 8 and 9 p. m. seventy-fifth meridian time. Such high winds as these doubtless prevail along the coast from the Golden Gate northward to Cape Mendocino and perhaps beyond.

In the eighties the United States Signal Service maintained an observing station at Cape Mendocino; during the lifetime of this station a maximum velocity of 144 miles per hour was reported.

The writer has examined the original wind sheet for the day on which this extraordinary velocity was reported, viz, January 20, 1886, 7 a. m. seventy-fifth meridain time, or approximately 4 a. m. local time. At this hour artificial light was necessary. The registering apparatus was of the standard type used in those days and the record was made by a pencil lead; naturally when high winds had prevailed for some time the pencil point became dulled and the record was accordingly, more or less difficult to read. The actual velocity at 7 a. m., read under the most favorable conditions as to light, was only about one-half of the reported velocity. Nevertheless the wind speed increased rapidly and a clearly indicated velocity of 120 miles per hour was reached at 11.30 a. m. of the same date, this high velocity continued unabated to about 1.15 p. m., when the observer sharpened the registering lead pencil, thus making it possible to read the indicated velocity with greater accuracy; at this time a velocity of 123.6 was clearly registered; shortly afterwards the register ceased to function and the remainder of the record was lost.

I have added the record of maximum monthly wind velocities at Cape Mendocino to Table 2.

Cape Mendocino is the most western point of California. The terrain back of the coast line is wooded and extremely rugged, the 1,000-foot contour line approaches to within 25 miles of the shore line and is much serrated directly east of the cape by gorges, canyons, and stream valleys that lead to the Pacific. Eighty miles to the southeast of the cape the hills which in that part of California trend almost north-south rise to an altitude of 4,000 feet. The winds which we are considering therefore are down-slope winds and consequently dry. That they advance any considerable distance over the Pacific is improbable but since they prevail only at such times as a pronounced depression of the barometer is approaching the coast it would appear that they must operate to prevent the depression from gaining a foothold over the continent.

DIURNAL VARIATION OF THE WIND

The statement has been made hereinbefore that the strength of the spring and early summer winds is conditioned, in part, by the strong temperature contrast between the heated interior and the coast. In further elaboration of that idea I have computed the mean hourly wind speed for the same 10-year period at both Point Reyes and Mount Tamalpais. The means appear in Table 3 and I have plotted the June means to form the two curves in Figure 2.

TABLE 3.—*Hourly wind velocities. Meridian of time used, 120°*

Date	1 a. m.	2 a. m.	3 a. m.	4 a. m.	5 a. m.	6 a. m.	7 a. m.	8 a. m.	9 a. m.	10 a. m.	11 a. m.	Noon	1 p. m.	2 p. m.	3 p. m.	4 p. m.	5 p. m.	6 p. m.	7 p. m.	8 p. m.	9 p. m.	10 p. m.	11 p. m.	Mid-night	Mean
Point Reyes																									
January	20.9	20.7	20.8	20.7	20.8	20.4	20.0	20.2	19.7	19.3	19.3	19.4	19.9	20.0	20.3	20.8	21.5	21.8	22.1	21.8	22.3	21.1	21.2	21.0	20.7
February	21.4	21.0	20.7	20.6	20.3	19.7	19.8	19.6	18.5	18.0	18.1	18.4	19.6	20.5	21.3	21.7	22.3	22.6	22.7	22.9	22.8	22.7	22.4	21.8	20.8
March	23.0	22.3	22.4	21.7	21.2	20.2	19.9	19.7	19.0	18.3	18.4	18.8	20.1	21.1	21.7	22.9	23.9	24.6	25.1	25.1	25.0	24.6	24.4	23.9	22.0
April	24.3	24.1	23.9	23.5	23.4	22.6	21.9	21.2	20.6	20.3	20.7	21.2	22.4	23.4	24.4	25.8	27.3	26.9	27.4	27.5	27.1	26.2	25.7	24.9	24.0
May	26.2	26.2	25.6	25.1	24.6	23.8	23.0	22.6	21.7	21.4	21.9	22.4	23.6	24.4	25.3	26.4	27.7	28.4	28.8	29.0	28.3	28.0	27.6	27.0	25.4
June	29.5	29.2	28.6	28.1	27.1	26.3	25.4	24.6	23.9	23.6	24.1	24.6	26.0	26.8	28.2	29.7	30.8	31.9	32.3	32.6	32.0	31.5	31.0	30.0	28.2
July	23.6	23.2	22.6	22.2	21.8	21.0	20.2	19.3	18.6	18.4	18.4	18.7	19.9	20.6	21.8	23.0	24.5	25.2	25.6	26.0	25.8	25.4	24.6	24.0	22.3
August	22.7	22.4	22.1	21.8	21.6	20.8	20.0	19.5	18.5	18.1	17.9	18.1	19.3	20.1	21.1	21.9	23.6	24.5	24.6	24.9	24.6	24.2	24.0	23.1	21.6
Mount Tamalpais																									
January	21.2	21.4	21.5	21.6	21.4	21.2	21.6	21.7	20.8	19.7	18.4	17.4	17.4	17.3	17.3	17.6	18.8	19.8	20.8	21.4	21.6	21.8	21.6	21.2	20.2
February	20.3	20.2	20.0	19.9	20.3	20.3	20.2	19.5	18.0	16.3	14.6	13.4	13.7	13.6	13.8	14.5	15.7	17.3	18.7	19.3	19.5	19.7	20.2	20.3	17.9
March	20.4	20.2	19.5	19.2	18.8	18.9	18.9	18.0	16.1	14.9	13.8	12.8	13.3	12.5	13.3	14.1	14.9	16.4	18.4	19.4	20.1	19.9	20.1	19.7	17.2
April	21.5	21.5	21.4	21.1	20.5	20.2	18.8	17.1	14.7	12.8	11.7	11.0	11.7	12.2	13.3	14.3	16.1	17.9	19.5	21.0	22.0	22.6	22.4	21.8	17.8
May	22.7	22.8	22.6	22.0	21.7	20.5	18.2	15.4	13.9	11.6	10.7	10.8	11.5	12.4	13.4	15.0	17.2	19.2	22.0	23.9	24.0	24.0	23.8	23.2	18.4
June	23.0	22.4	21.7	21.5	20.7	18.8	16.8	14.1	12.8	9.9	9.0	7.8	9.4	10.1	11.6	13.4	15.8	18.2	20.6	22.8	24.4	24.5	24.4	23.6	17.4
July	18.9	18.2	17.8	17.5	17.2	15.7	14.0	12.2	10.5	9.0	7.8	7.0	7.0	7.3	8.1	9.6	12.4	14.8	17.3	19.2	20.5	20.8	20.5	19.3	14.3
August	18.4	17.9	17.6	17.0	16.8	15.6	14.0	11.7	10.2	8.7	7.8	7.4	7.6	7.8	8.5	10.1	12.0	13.9	16.3	18.3	19.9	20.3	20.0	19.1	14.0

The chief point of interest in the above table is in the relatively large increase in the speed of the wind at Point Reyes from winter to early summer, especially at the hour of daily maximum. In January the daily maximum is 22.3 miles per hour at 9 p. m.; in June the daily maximum is 32.6 miles per hour, an increase of 10.3 over and above that of January. This increase begins in March and with the coming of summer reaches the value just quoted. At the other station, Mount Tamalpais, the speed of the wind falls off from a maximum in January to a minimum in August, as shown in the annual curves in Figure 2.

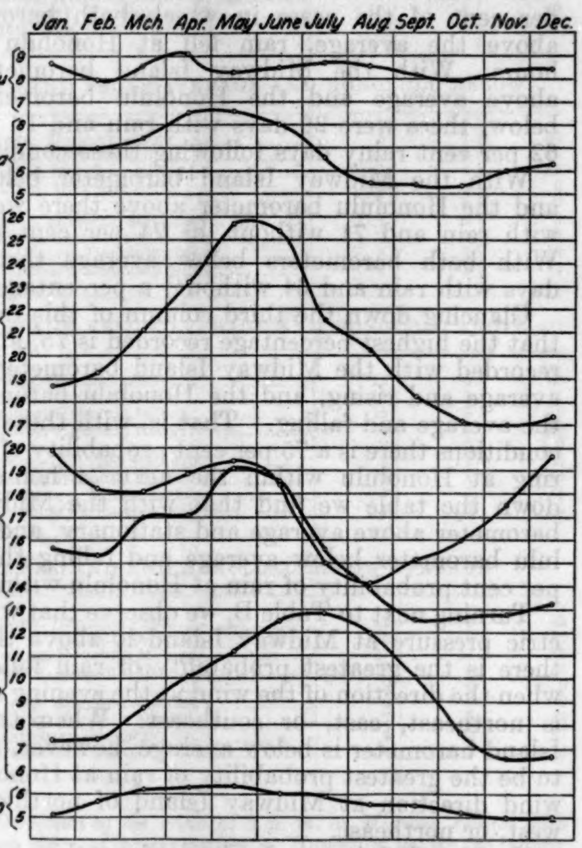


FIG. 2.—Annual march of wind velocity at certain California stations and Honolulu

The range in hourly wind speed at Point Reyes in January is 3 miles per hour; in March as the temperature of the interior rises it is 6.8 miles per hour and in June has risen to 9 miles per hour, a threefold increase over January. Mount Tamalpais, with the same range in January as Point Reyes, increases more rapidly as the warm season comes on, being 7.9 miles per hour in March and 16.7 in June. Other details appear in Table 3.

Another point of interest in the diurnal winds of the middle California coast is the delayed occurrence of the morning minimum until 10 o'clock in the forenoon. This feature comes somewhat as a surprise, although it need not, since the writer published in the annual report of the Chief of the Weather Bureau, 1896–7 pages 110–123, statistics of hourly wind velocities which show for the two stations San Francisco, Calif., and Portland, Oreg., a lag of several hours in the occurrence of the morning minimum as well as the afternoon maximum. The statistics here referred to are for seventy-fifth meridian time while those used in the present compilation are for one hundred and twentieth meridian. San Diego on the south coast of California does not show the characteristic above mentioned.

The diurnal variation at Mount Tamalpais, follows that of Point Reyes with a lag of about 2 hours in the occurrence of the morning minimum and the afternoon maximum, respectively. The daily range in velocity at Tamalpais is considerably greater than that at Point Reyes, as might be expected considering that the latter is a mountain station.

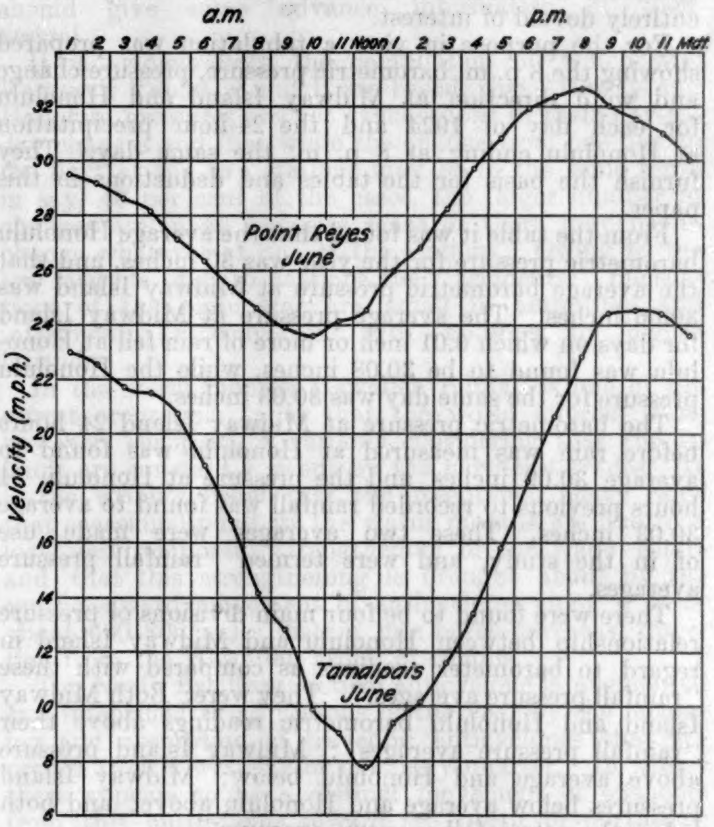


FIG. 3.—Hourly March of wind velocity in June, at Point Reyes and Mount Tamalpais

Von Hann investigated the diurnal wind movement at mountain stations many years ago. He found for the Sonnblick in the Austrian Alps, and for other mountain stations, a retardation in the time of the morning minimum and attributed it to a temperature effect on the mountain sides. In the case here considered it seems probable that the temperature effect of the Great Valley of California overshadows any temperature effect due to the slopes of Tamalpais itself, and that consequently the winds of that station join in the general northwest current that originates at sea, probably not far from the coast line, passes over the coast range of mountains and mingles with the air over the Great Valley.

LITERATURE CITED

(1) MCADIE, A. G., and THOMAS, W. W.
1903. SOME HIGH WINDS ON THE PACIFIC COAST. Mo. Wea. Rev., 31: 65.

RAINFALL AT HONOLULU IN RELATION TO BAROMETRIC PRESSURE AT MIDWAY ISLAND AND HONOLULU

By WALTER G. RAMSAY

[Weather Bureau Office, Honolulu, Hawaii, November, 1925]

An attempt has been made by the writer to find a relationship between barometric pressure at Midway Island and Honolulu and rainfall at Honolulu within the following 24 hours for the purpose of discovering a method of increasing the accuracy of the forecasts of rainfall at Honolulu. Although the attempt has been a failure in so far as finding a method of forecasting rain at Honolulu is concerned, the results of the study are not entirely devoid of interest.

For the purpose in view a tabulation was prepared showing the 8 p. m. barometric pressure, pressure change and wind direction at Midway Island and Honolulu for each day of 1924 and the 24-hour precipitation at Honolulu ending at 8 p. m. the same day. They furnish the basis for the tables and deductions in this paper.

From the table it was found that the average Honolulu barometric pressure for the year was 30 inches, and that the average barometric pressure at Midway Island was 30.06 inches. The average pressure at Midway Island for days on which 0.01 inch or more of rain fell at Honolulu was found to be 30.08 inches, while the Honolulu pressure for the same day was 30.03 inches.

The barometric pressure at Midway Island 24 hours before rain was measured at Honolulu was found to average 30.09 inches and the pressure at Honolulu 24 hours previous to recorded rainfall was found to average 30.03 inches. These two averages were made use of in the study, and were termed "rainfall pressure averages."

There were found to be four main divisions of pressure relationship between Honolulu and Midway Island in regard to barometer readings as compared with these "rainfall pressure averages." They were: Both Midway Island and Honolulu barometric readings above their "rainfall pressure averages"; Midway Island pressure above average and Honolulu below; Midway Island pressures below average and Honolulu above; and both below their "rainfall pressure averages."

Under each of these four main divisions there were found to be nine further divisions, as regards the pressure changes having taken place during the preceding 24 hours. These nine divisions were: Midway Island barometer rising and Honolulu barometer rising; Midway Island barometer rising and Honolulu barometer falling; Midway Island barometer falling and Honolulu barometer falling; Midway Island barometer falling and Honolulu barometer rising; both Midway Island and Honolulu barometers stationary; Midway Island barometer rising and Honolulu barometer stationary; Midway Island barometer falling and Honolulu stationary; Midway Island barometer stationary and Honolulu barometer rising; and Midway Island barometer stationary and Honolulu barometer falling. From this it is seen that there were 36 different combinations of pressure relationship possible.

Table A presents a summary of first, the total number of days with each of the possible pressure relationships; second, the number of days with rain at Honolulu that followed days with each of the combinations; and third, the percentage of days with rain as compared with the total number of days with each pressure combination.

From Table A it may readily be seen that there were 128 days during the year when both the Midway Island and the Honolulu barometers read above the rainfall pressure averages (that is, 30.09 inches at Midway Island and 30.03 inches at Honolulu). Of this number, 61 days were followed, within 24 hours, by 0.01 inch or more of precipitation at Honolulu; and 67 days without rain within the following 24 hours; that is, in 48 per cent of the cases in which both barometers were above the average, rain fell at Honolulu within 24 hours. With the Midway Island barometer reading above average and the Honolulu barometer reading below, there were 26 days with rain and 16 without, or 62 per cent rainy days following these conditions.

With the Midway Island barometer below average and the Honolulu barometer above there were 21 days with rain and 71 without, or 24 per cent rainy days. With both barometers below average there were 38 days with rain and 64 without; a percentage of 37.

Glancing down the third column of this table we find that the highest percentage recorded is 75, and that it is recorded with the Midway Island barometer above the average and rising, and the Honolulu barometer below the average and falling. That is, with these barometric conditions there is a 75 per cent probability of rain occurring at Honolulu within the next 24 hours. Further down the table we find that with the Midway Island barometer above average and stationary, and the Honolulu barometer below average and falling there is a 71 per cent probability of rain at Honolulu within 24 hours.

Turning next to Table B, we observe that when barometric pressure at Midway Island is above the average, there is the greatest probability of rain following days when the direction of the wind at the evening observation is northeast, east, or southeast. When the Midway Island barometer is below average, however, there seems to be the greatest probability of rain at Honolulu with a wind direction at Midway Island of northwest, southwest, or northeast.

Nothing definite can be drawn from this short study of pressure distribution and rainfall, because there has been discovered no one set of conditions when rain will invariably fall, or rain invariably will not fall. The most that can be said is this: That there seems to be the greatest probability of 0.01 inch or more of rain within 24 hours of the following conditions: Midway Island barometer above 30.09 inches and rising, with a northeast wind, and Honolulu's barometer below 30.03 inches and falling. In any event, it would seem that there is the greater probability of rain at Honolulu following a Midway Island barometer of over 30.09 inches, and a Honolulu barometer of below 30.03 inches.

It is more than likely that the pressure averages used may not be the correct ones, and that with further investigation the proper ones may be found. In the meantime, this preliminary study may serve to suggest further methods of finding a close connection between pressure or wind at Midway Island and rainfall at Honolulu. At present, even if the probability percentages as given are correct, none of them are sufficiently high to warrant their being used as a basis for forecast work, the ultimate object of the study.

TABLE A.—*Total number of days with each barometric condition, number of days with rain within 24 hours, and percentage of days with rain*

MIDWAY ISLAND AND HONOLULU ABOVE AVERAGE

Barometric conditions	Total rain	Days with rain	Percentage of days with rain
Midway Island rising, Honolulu rising	36	16	45
Midway Island rising, Honolulu falling	22	12	55
Midway Island falling, Honolulu falling	19	10	53
Midway Island falling, Honolulu rising	14	6	43
Both stationary	8	2	25
Midway Island rising, Honolulu stationary	6	3	50
Midway Island falling, Honolulu stationary	6	4	67
Midway Island stationary, Honolulu rising	10	4	40
Midway Island stationary, Honolulu falling	7	4	57
MIDWAY ISLAND ABOVE AVERAGE AND HONOLULU BELOW			
Midway Island rising, Honolulu rising	5	3	60
Midway Island rising, Honolulu falling	12	9	75
Midway Island falling, Honolulu falling	9	6	67
Midway Island falling, Honolulu rising	0	0	0
Both stationary	1	0	0
Midway Island rising, Honolulu stationary	1	0	0
Midway Island falling, Honolulu stationary	3	1	33
Midway Island stationary, Honolulu rising	4	2	50
Midway Island stationary, Honolulu falling	7	5	71
MIDWAY ISLAND BELOW AVERAGE AND HONOLULU ABOVE			
Midway Island rising, Honolulu rising	15	5	33
Midway Island rising, Honolulu falling	18	2	11
Midway Island falling, Honolulu falling	16	3	19
Midway Island falling, Honolulu rising	24	8	33
Both stationary	0	0	0
Midway Island rising, Honolulu stationary	7	1	13
Midway Island falling, Honolulu stationary	2	1	50
Midway Island stationary, Honolulu rising	9	1	13
Midway Island stationary, Honolulu falling	1	0	0
MIDWAY ISLAND AND HONOLULU BELOW AVERAGE			
Midway Island rising, Honolulu rising	12	5	42
Midway Island rising, Honolulu falling	16	9	56
Midway Island falling, Honolulu falling	37	11	30
Midway Island falling, Honolulu rising	18	6	33
Both stationary	3	0	0
Midway Island rising, Honolulu stationary	0	0	0
Midway Island falling, Honolulu stationary	7	3	43
Midway Island stationary, Honolulu rising	3	2	67
Midway Island stationary, Honolulu falling	6	2	33

TABLE B.—*Direction of the wind at 8 p. m. at Midway Island with 0.01 inch or more of precipitation at Honolulu within 24 hours, and Midway Island barometer above or below the average of 30.09 inches*

	Above average	Below average		Above average	Below average
N	1	3	SW	6	10
NE	37	12	W	0	2
N	15	5	NW	3	15
SE	18	9	Calm	1	1
S	1	0			

Discussion.—The author of the above paper need not feel discouraged in his attempt to deduce useful precepts for predicting the precipitation of Honolulu from the day-to-day pressure changes and other conditions at Midway Island, distant about 1,500 miles in a west-northwest direction.

As a general proposition, precipitation in the Hawaiian group, especially in the months November to April, is conditioned upon the intensity and frequency of the passage of barometric troughs across the islands during those months. Since these troughs, locally known as "Kona" storms, move as a rule from northwest to southeast, it is reasonable to suppose that Midway pressures should give some advance information of their arrival.

It is evident from the compilation on which Mr. Ramsay's Tables A and B are based, that Midway and Honolulu pressures are not synchronous in their day-to-day changes and that while the change from one day to the next at the two stations may be in the same sense in say, 40 per cent of the cases, the larger number of changes are in an opposite sense or there may be no change whatever at one of the stations. Owing to the low latitude of both stations the "accidental" fluctuations of the barometer are small in amplitude and infrequent as compared with stations in higher latitudes.

In the warm months Hawaiian rainfall is one of the purest orographic types that the world affords; it is, however, surprisingly variable considering that the islands are constantly swept by the northeast trades. It is the writer's belief that the exceptional heavy rains that occasionally fall in the warm months are due to a local and temporary strengthening of the trade winds and that this strengthening is brought about by the southeastward movement of anticyclones along a track about 600–800 miles distant in a north-northeast direction from the Hawaiian group of islands.

The North Pacific statistical anticyclone is augmented and intensified at all seasons of the year by the incoming and absorption of traveling anticyclones that approach from a westerly or northerly quarter. In winter there appears to be a distinct movement of offshoots from this anticyclone toward the north or northeast; in the warm season this movement is perhaps the same but is more difficult of identification. In exceptional seasons an easterly movement to the California coast has been suspected as the reason for exceptionally cloudy weather with fog on the coast and showers in higher altitudes.

Statistical evidence of the anticyclonic movement above mentioned is becoming easier to obtain by reason of an increased number of ship observations in the Pacific.—*A. J. H.*

ASCENSIONAL RATE OF PILOT BALLOONS FROM OBSERVATIONS AT PAVLOVSK, RUSSIA

By P. MOLTCHANOFF

[Abstracted and discussed by W. C. Haines on the basis of a translation by A. J. Montzka from "Annalen der Hydrographie und Maritimen Meteorologie," March, 1925]

This paper gives the results of a critical study of 506 two-theodolite observations taken during the year 1923 at the Aerological Observatory at Pavlovsk, Russia. One-half of the observations were taken in the forenoon (7 a. m.) and the other half near the noon hour (1 p. m.). The weight of the uninflated balloons averaged about 75 grams. They varied in ascensional rate, several being filled to give an assumed rate of ascent as great as 220 meters per minute as determined by Hesselberg's tables.

A number of tables and figures are given in the article to show the relations existing among the various factors which determine the ascensional rate. In this abstract, Table I of the original is reproduced as Table 1; II and III as 2; VI as 3; VII as 4; Figure 3 as Figure 1.

TABLE 1.—*Mean departures, for various levels, of the actual ascensional rate of the balloons from the assumed rate for the year; also for the winter half year and the summer half year*

Altitude (km.)	Year		Winter		Summer		Altitude (km.)	Year		Winter		Summer	
	7 or 8 a. m.	1 p. m.	8 a. m.	1 p. m.	7 a. m.	1 p. m.		7 or 8 a. m.	1 p. m.	8 a. m.	1 p. m.	7 a. m.	1 p. m.
0.1	50	68	47	53	52	77	2.5	−6	−7	−9	−11	−5	−6
0.2	41	65	41	52	46	72	3.0	−7	−10	−4	−7	−9	−10
0.3	34	55	26	35	38	65	3.5	−7	−7	−8	−10	−7	−6
0.4	14	46	40	20	18	58	4.0	−11	−9	−18	−9	−9	−8
0.5	10	46	−0.3	21	15	57	4.5	−19	−7	−31	0	−16	−7
0.6	3	40	−2	12	6	51	5.0	−24	−15	−58	−3	−19	−16
0.8	−2	25	−9	−2	0.3	36	5.5	−23	−20			−22	−20
1.0	−3	18	−4	−7	−3	28	6.0	−29	−7			−29	−7
1.25	−5	6	−1	−13	−7	13	6.5	−40	−10			−39	−10
1.5	−7	5	−6	−14	−8	11	7.0	−54	−10			−54	−10
1.75	−9	−2	−6	−17	−10	3	7.5	−28				−28	
2.0	−9	−5	−9	−17	−8	−1	8.0	−28				−28	
2.25	−5	−8	−4	−13	−4	−6							

From Table 1 it is evident that in the lower levels even in winter the departures of the actual from the assumed ascensional rates reach large plus values. At the 100-meter level, in winter the actual ascensional rate is 24 per cent greater than the assumed, and in summer 35 per cent greater. The departures become smaller with altitude; that is, the actual ascensional rate gradually comes nearer to the assumed. In winter and in the mornings of summer the departures are smaller, the zero value being reached at the 500-meter level, whereas at the summer noon hour this value is not reached until the 2,000-meter level. Negative departures show an increase at the 5,000-meter level, which fact, the author points out, seems to agree with the lessening of the lifting power caused by the loss of hydrogen.

In the winter there is little difference in the departures in the forenoon and afternoon; also there is little difference between the winter departures and the summer morning departures. The author attributes the large values reached in the summer afternoons to thermal turbulence, or convection, due to warming up of the earth's surface by the sun, while the smaller values of winter and summer mornings he explains as due to mechanical turbulence caused by movements of air masses over the earth's surface. This explanation is borne out by Table 2, which shows that the departures vary with the wind velocity, the larger plus departures occurring with the stronger wind. The effect of wind velocity on the rate of ascent can be seen in both morning and noon hour observations in winter, whereas in the summer noon-hour observations the effect is reversed, the stronger plus departures occurring with the light winds. Here the thermal turbulence is so pronounced as to overcome the effect of the strong winds entirely. Conclusions are drawn from both tables that the effect of wind velocity on the ascensional rate is confined to the lower levels of the atmosphere where turbulence is pronounced. Above 400 to 600 meters the departures for strong as well as light winds become of the same order of magnitude. The author invites attention to the fact that the increase of wind velocity in the upper layers can be independent of the turbulence process, a condition which he and others have shown does not prevail near the surface.

TABLE 2.—*Mean departures of the actual from the assumed rate of ascent compared with the wind velocity at the 1,000-meter level, for the winter and summer half years*

Altitude (km.)	Wind velocity at 1,000 m. level							
	0-4 m. s.		5-8 m. s.		9-12 m. s.		13-16 m. s.	
	8 a. m.	1 p. m.	8 a. m.	1 p. m.	8 a. m.	1 p. m.	8 a. m.	1 p. m.
WINTER								
0.1	+14.0	+32.5	+39.7	+48.3	+57.6	+66.8	+93.0	+49.1
0.2	+14.6	+43.2	+16.4	+43.2	+39.1	+62.8	+80.3	+46.0
0.3	+5.3	+17.5	+10.8	+34.0	+23.0	+30.4	+75.3	+42.5
0.4	+6.6	+9.9	+10.9	+19.6	−14.5	+29.7	+38.1	−6.1
0.5	−3.0	+4.9	+3.5	+18.1	−15.1	+32.3	+25.2	−2.4
0.6	−12.0	−15.4	+1.4	+1.9	−20.8	+40.3	+25.5	−10.8
0.8	−3.5	−4.9	−6.0	−6.3	−21.2	+2.0	+8.0	+3.2
1.0	−8.0	−7.3	−4.6	−9.6	−13.3	−7.5	−12.0	−21.0
SUMMER								
0.1	+41.7	+81.8	+48.0	+84.6	+46.6	+65.6	+80.4	+79.7
0.2	+36.6	+77.5	+37.3	+73.6	+45.5	+71.0	+72.6	+61.7
0.3	+37.2	+72.6	+34.7	+72.1	+36.4	+58.6	+52.7	+57.8
0.4	+18.1	+56.7	+16.2	+62.6	+14.5	+66.9	+33.2	+36.8
0.5	+14.4	+58.8	+14.5	+62.0	+11.1	+71.0	+20.0	+33.2
0.6	+10.7	+52.1	+6.8	+68.3	−2.7	+66.4	+11.8	+8.3
0.8	+2.0	+30.7	+5.4	+50.2	−10.3	+49.0	+6.1	+0.2
1.0	−3.4	+32.1	−3.6	+34.7	−7.6	+27.4	+5.1	+19.5

From Table 3 it is apparent that, especially in the morning hours, the balloons show a higher ascensional rate with winds from the northerly quadrants than with winds from the southerly. But this applies only to the lower levels, below 400 or 500 meters. The reason for this given by the author is that the larger temperature lapse rate of northerly winds near the surface in comparison with that of the southerly winds is the predominating factor.

TABLE 3.—*Mean departures of the actual ascensional rate from the assumed, for different wind directions for various levels up to 1,000 meters*

Wind direction	Altitude (km.)							
	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0
MORNING								
NE	56	49	35	16	6	4	−9	−3
SE	31	29	19	4	0	1	3	2
SW	45	37	30	10	9	2	−1	−7
NW	61	50	44	20	14	3	0	−4
AFTERNOON								
NE	54	56	48	50	51	44	29	19
SE	54	54	47	36	29	35	16	15
SW	78	70	52	48	47	42	28	26
NW	70	70	67	51	52	40	24	14

In the morning hours, at least, the ascensional rate attains larger values in periods of falling temperature, especially at their beginning, than in periods of rising temperature. At the noon hour this difference disappears. This is shown by Table 4. From the rising periods there was separated a period of little change in temperature, given in the table as the normal. The values for this normal period are smaller than those for the cold, and larger than those for the warm period; and these normal values come close to the values for the year given in Table 1.

TABLE 4.—*Mean departures of ascensional rate for falling temperature periods (−A and −B) and for rising temperature periods (A and B) for various levels up to 1,000 meters. The values for Group A are for the beginning of the periods and those of B for their ends*

Altitude (km)	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0
				Morning				
−A	58	59	46	22	18	7	−1	10
−B	55	44	39	21	15	10	8	11
+A	50	27	21	8	6	2	−6	−6
+B	45	33	29	7	7	−6	−8	−3
Normal	59	43	36	12	9	2	−2	−10
				Afternoon				
−A	87	77	60	59	60	46	39	28
−B	54	53	48	38	37	35	25	20
+A	57	58	47	32	32	27	15	14
+B	84	66	53	46	51	44	41	26
Normal	70	67	58	49	48	44	20	15

From the foregoing and other facts brought out in his study, the author concludes that the ascensional rate of balloons is affected not only by the aerodynamical qualities of a given balloon but also by the weather conditions to a large degree. In view of this fact he thinks the investigation of all conditions which are connected with the movement of pilot balloons is doubly important, as this leads not only to a fuller development of the theory of methods of research into the velocity of air streams, but also indicates a procedure which enables us to express a characteristic of the atmospheric conditions of the air strata.

The author compares the results of his investigation with the results obtained in this country. (*1*) He finds that the departures as given in an article on the ascensional rate of balloons published by the reviewer are much smaller than those obtained from the observations taken in his country. For an explanation he gives the following: The conditions of the movements of a balloon in the atmosphere are mostly determined by the resistance offered by the atmosphere. According to the experiment by Prandtl (*2*) the coefficient of resistance of the balloon does not bear a constant relation to the velocity of the balloon but varies with the so called "Reynold's number," $R=\frac{\rho v D}{\eta}$ in which ρ is the density of the air; v, the velocity of the balloon; D, the diameter of the balloon; and η, the molecular viscosity of the air; and it also varies with the air conditions. It is shown that the greatest difference between the coefficient of friction for still and turbulent air occurs when the Reynolds' number is between 100,000 and 200,000. Hesselberg has shown that for pilot balloons it is enough to assume that the Reynolds' number is proportional to the lifting power of the balloon. Therefore from Prandtl's results it might be expected that the difference in the movements of the balloons in still and turbulent air would vary with the free lift of the balloon. This is shown by Figure 1. The greatest departures occur with balloons with a 200-gram lift as used in Russia. The balloon with a 150-gram lift shows smaller departures, and the smallest departures occur with balloons of about 70 grams free lift. From the foregoing the author concludes that by taking observations with one theodolite it would be better to use a free lift of only 70 or 80 grams. In order to get high enough ascensional rate he suggests using balloons of smaller weight.

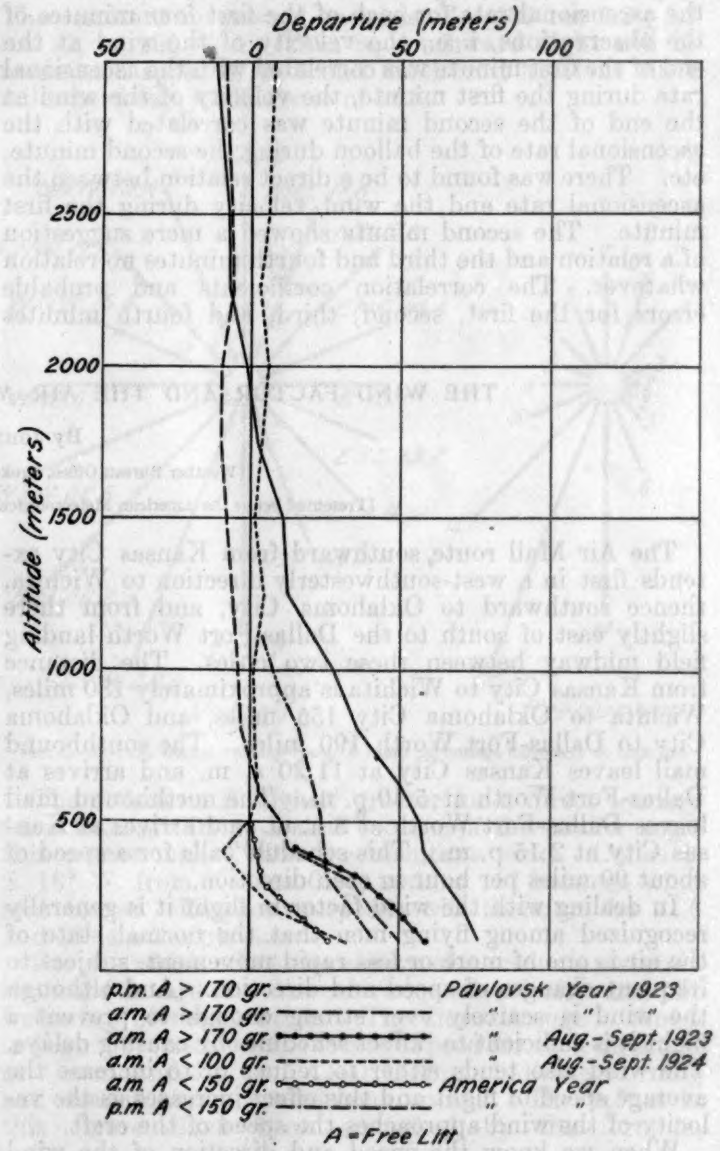


FIG. 1.—Curves showing the relation of the mean departures of the ascensional rate from the assumed, with the free lift of the balloon

DISCUSSION

In the study of the ascensional rate of pilot balloons referred to by the author, the reviewer made no attempt to show whether or not a relation exists between the ascensional rate of the balloon and the velocity of the wind, the primary object of the study being to verify the ascensional rate formula in use. Since that time, however, the reviewer has made a careful study of two-theodolite observations in order to determine the effect of wind velocity on the ascensional rate. It is of interest

to give the results of this study here as they verify the results obtained by Moltschanoff in this connection.

In this study 418 two-theodolite observations made at various aerological stations in the United States were selected. The only criterion used in the selection was that they be taken early in the morning so as to exclude the effects of thermal convection. Consequently only observations taken before 8 a. m. were used. The balloons weighed 25 to 35 grams and were filled to give an ascensional rate of 180 meters per minute or to a free lift of from 120 to 130 grams, depending upon their weight. The velocity of the wind was correlated with the ascensional rate for each of the first four minutes of the observations, i. e., the velocity of the wind at the end of the first minute was correlated with the ascensional rate during the first minute, the velocity of the wind at the end of the second minute was correlated with the ascensional rate of the balloon during the second minute, etc. There was found to be a direct relation between the ascensional rate and the wind velocity during the first minute. The second minute showed a mere suggestion of a relation and the third and fourth minutes no relation whatever. The correlation coefficients and probable errors for the first, second, third, and fourth minutes were found to be $+0.507 \pm 0.024$, $+0.172 \pm 0.032$, $+0.012 \pm 0.033$, and $+0.008 \pm 0.033$.

It may be of interest also to know that the average ascensional rates for the first four minutes were, 198.4, 180.5, 178.0, and 179.1 meters per minute, respectively, and the standard deviations from these averages were 18.7, 15.8, 16.1, and 15.6 meters, respectively.

It is noted that the results of this investigation are in close agreement with those given by Moltchanoff with balloons of approximately the same free lift. Investigations of the ascensional rate of pilot balloons (*3*) made by Capt. B. J. Sherry are also in accord with the results obtained by Moltschanoff in so far as the effect of wind velocity on the ascensional rate is concerned.

LITERATURE CITED

(*1*) HAINES, W. C.
1924. ASCENSIONAL RATE OF PILOT BALLOONS. Mo. Wea. Rev., 52: 249–253.

(*2*) PRANDTL. L.
1914. DER LUFTWIDERSTAND VON KUGELN. Nachr. d. K. Gesellsch. d. Wiss. zu Göttingen, Ann. d. Hydrogr. usw. 1917, S. 124–131.

(*3*) SHERRY, B. J.
1920. THE RATE OF ASCENT OF PILOT BALLOONS. Mo. Wea. Rev., 48: 692–694.

THE WIND FACTOR AND THE AIR MAIL SOUTHWARD FROM KANSAS CITY

By JOHN A. RILEY

[Weather Bureau Office, Broken Arrow, Okla., January 20, 1926]

[Presented before the American Meteorological Society at Kansas City, Mo., December 28, 1925]

The Air Mail route southward from Kansas City extends first in a west-southwesterly direction to Wichita, thence southward to Oklahoma City, and from there slightly east of south to the Dallas-Fort Worth landing field midway between these two cities. The distance from Kansas City to Wichita is approximately 180 miles, Wichita to Oklahoma City 155 miles, and Oklahoma City to Dallas-Fort Worth 190 miles. The southbound mail leaves Kansas City at 11:20 a. m. and arrives at Dallas-Fort Worth at 5:40 p. m. The northbound mail leaves Dallas-Fort Worth at 8 a. m. and arrives at Kansas City at 2.15 p. m. This schedule calls for a speed of about 90 miles per hour in each direction.

In dealing with the wind factor in flight it is generally recognized among flying men that the normal state of the air is one of more or less rapid movement, subject to frequent changes of speed and direction. And although the wind is scarcely ever strong enough to prevent a flight it is sufficient to affect schedules by causing delays. The wind also tends either to reduce or to increase the average speed of flight and this effect increases as the velocity of the wind approaches the speed of the craft.

When we know the speed and direction of the wind and the cruising speed of the craft the resultant speed is readily computed. We first find the angle the craft must make with the course to overcome the effect of drift. This is called the β angle; the angle between the wind and the course is the α angle. β is found by the formula,

$$\sin \beta = \frac{S_w}{S_a} \sin \alpha$$

in which S_w and S_a are the wind speed and the craft speed, respectively. In flying where no landmarks are visible, as above clouds or over water surfaces out of sight of land, this angle must be computed or estimated. After it is obtained the resultant speed of craft is found by the formula [1]

$$S_r = S_a \cos \beta \pm S_w \cos \alpha$$

Figure 1 represents the surface winds at Broken Arrow. It is based on a five-year period of continuous hourly records. The average speed and the percentage frequency of the eight directions are shown.

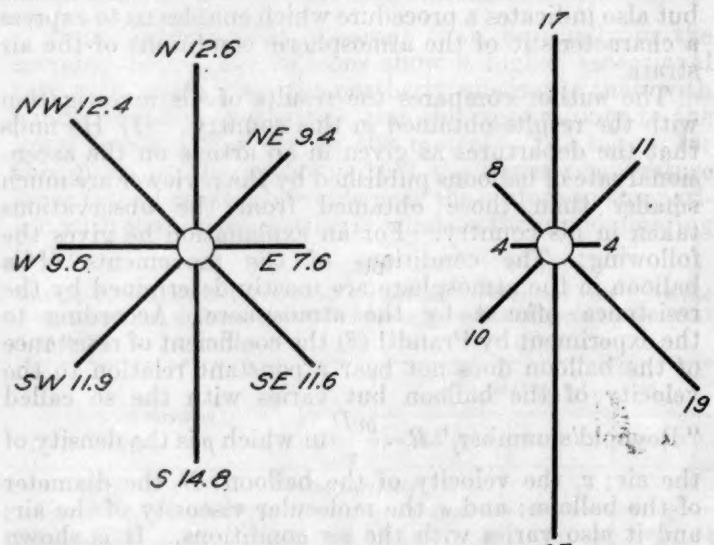


FIG. 1.—Average annual velocity (m. p. h.) and percentage frequency of surface winds, Broken Arrow, Okla., based on continuous automatic records

[1] Graphs for readily obtaining these data as well as other information of practical value in aerial navigation may be found in a paper "The weather factor in aeronautics," by Dr. C. L. Meisinger, who was until his death a pioneer in aeronautical meteorology. (Mo. Wea. Rev., Dec., 1920.)

In a previous study wind data were published for Fort Sill, Okla., and Groesbeck, Tex., as well as for Broken Arrow (*1*). Close similarity was found to exist in the surface and free-air winds at flying levels at the three places. The free-air data in the present paper are based on a six-year record of daily pilot-balloon ascents at Broken Arrow.

While Broken Arrow is not on the air mail route, which passes considerably to the westward, it is near the halfway point on a direct line from Kansas City to Dallas, and therefore represents fairly well the winds along most of this route.

A comparison of the average winds of this region with published reports for stations in other parts of the country indicates that the southern Plains States are somewhat peculiar in the large number of north and south winds compared to those from east or west. As will be seen in Figure 1, combined east and west winds at Broken Arrow amount to only 8 per cent while 44 per cent come from north or south. North and south winds also have a consierably higher average speed than east and west winds. The strongest wind is south and the weakest is east.

Published data show that as one proceeds northward along this route a somewhat higher average speed and an increasing percentage of a north component will be found in the surface winds.

TABLE 1.—*Average speed and frequency of wind at 1,600 feet*

	Speed, m. p. h.					Frequency (per cent)				
	Spring	Summer	Autumn	Winter	Annual	Spring	Summer	Autumn	Winter	Annual
N	22.1	12.8	20.1	22.1	19.3	6	3	8	9	7
NNE	16.8	14.1	19.0	20.6	17.6	6	3	7	7	6
NE	21.9	13.0	17.0	19.5	17.8	5	5	5	7	6
ENE	16.6	13.2	12.8	14.8	14.4	4	3	2	3	3
E	14.5	12.3	11.4	14.1	13.1	2	2	3	2	2
ESE	18.8	9.6	10.7	15.7	13.7	2	3	1	1	2
SE	18.8	12.5	9.8	18.6	14.9	4	4	3	2	3
SSE	21.7	14.1	18.3	18.1	18.0	7	8	7	4	6
S	28.4	18.8	21.7	21.9	22.7	16	17	16	7	14
SSW	31.5	24.4	26.6	29.3	28.0	18	21	18	14	18
SW	25.7	24.8	26.6	27.5	26.2	8	15	13	13	12
WSW	23.7	25.7	19.2	21.7	22.6	3	7	4	7	5
W	19.7	13.9	21.3	19.5	18.6	4	3	4	6	4
WNW	17.9	11.9	15.7	19.7	16.3	4	1	2	4	3
NW	20.4	14.1	18.8	17.2	17.6	4	2	3	8	4
NNW	20.8	12.3	21.5	23.0	19.4	7	3	4	6	5

Passing to the 1,600-foot (500-meter) level above the surface, which is considered as the average altitude of flight, we find that the greatest frequency of direction has shifted from the southeast to the southwest quadrant (fig. 2, Table 1). Forty-four per cent of all winds are from three directions—south to southwest. These are also the strongest winds, the highest average being 28 miles per hour from the SSW. Winds of least frequency and speed are easterly, the quadrant ENE. to SE. having a total of only 10 per cent and an average speed of 14 miles per hour. A secondary maximum both of frequency and speed is north and a secondary minimum is WNW.

Messrs. Gregg and Van Zandt have dealt in a most thorough manner with the wind factor along the transcontinental Air Mail route, and these works (*2*) should be consulted for a full discussion of the subject.

The transcontinental route, lying in an east-west direction, was found to have a resultant wind of 7.4 miles per hour from the west; this value agreed closely with the record of performance of the mail planes for the year. Along the southward extension of the Air Mail here considered resultant winds favor the south by practically the same amount. The resultant wind at Broken Arrow is S. 32° W., 8.7 miles per hour.

Substituting this value in the equations for resultant speed and direction of craft we find that over a north-south course a plane with a cruising speed of 100 miles per hour will have to make an angle of 2.5° with the course to overcome the effect of drift,

$$\sin \beta = \frac{8.7}{100} \sin 32°.$$

$$\beta = 2.5°.$$

The resultant or ground speed is, $S_r = 100 \cos 2.5 \pm 8.7 \cos 32$, or 100 ± 7.4. That is, southward flight will be made at a speed of 92.6 and northward flight at 107.4 miles per hour, a difference of 14.8.

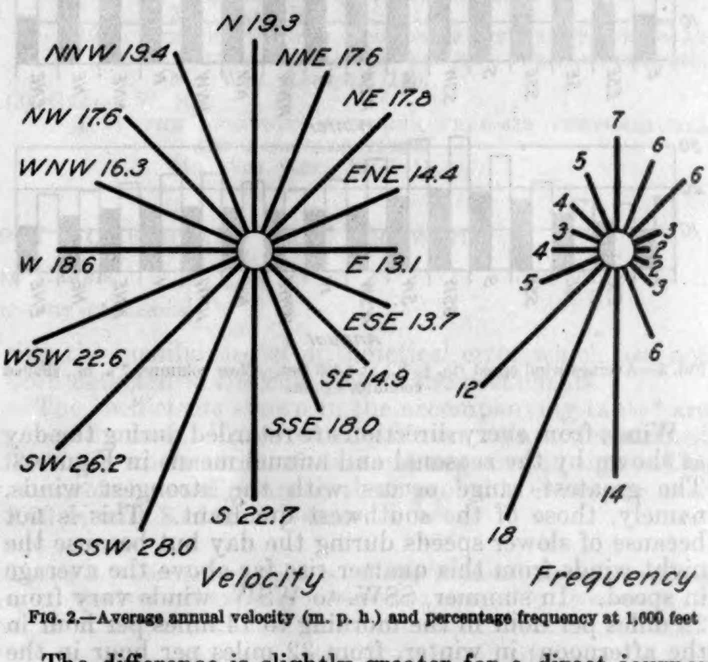


FIG. 2.—Average annual velocity (m. p. h.) and percentage frequency at 1,600 feet

The difference is slightly greater for a direct journey from Kansas City to Dallas because of the smaller angle this course makes with the resultant wind. Dallas is S. 16° W. from Kansas City, making 16° between wind and course. Respective speeds will therefore be 91.6 and 108.4 miles per hour.

Factors which affect the ability of a craft to maintain its schedule are the diurnal range of velocity and the frequency of strong winds. The diurnal range is shown in Figure 3, based on the average speed for each direction at 7 a. m. and 3 p. m. Clear columns indicate morning and shaded columns afternoon speeds. The values in this figure have been smoothed by the formula, $b = \frac{a + 2b + c}{4}$.

The morning observation shows typically nocturnal conditions, while the one at 3 p. m. occurs at the time of greatest diurnal effect. The two observations therefore show the extremes of the daily range.

One is accustomed to the fairly regular daily range in the surface wind but one is likely to be surprised at the magnitude and universality of the range at 1,600 feet. The changes at this level are just the reverse of those at the surface, for while surface winds are strongest during the day, free-air winds are strongest at night. The average difference for the year is 10 miles per hour and varies from 12 in summer to 8 in winter.

This daily range may also be seen in the resultant winds. In the morning the resultant is S. 38° W., 11.2 miles per hour and in the afternoon it is S. 23° W., 5.9 miles per hour.

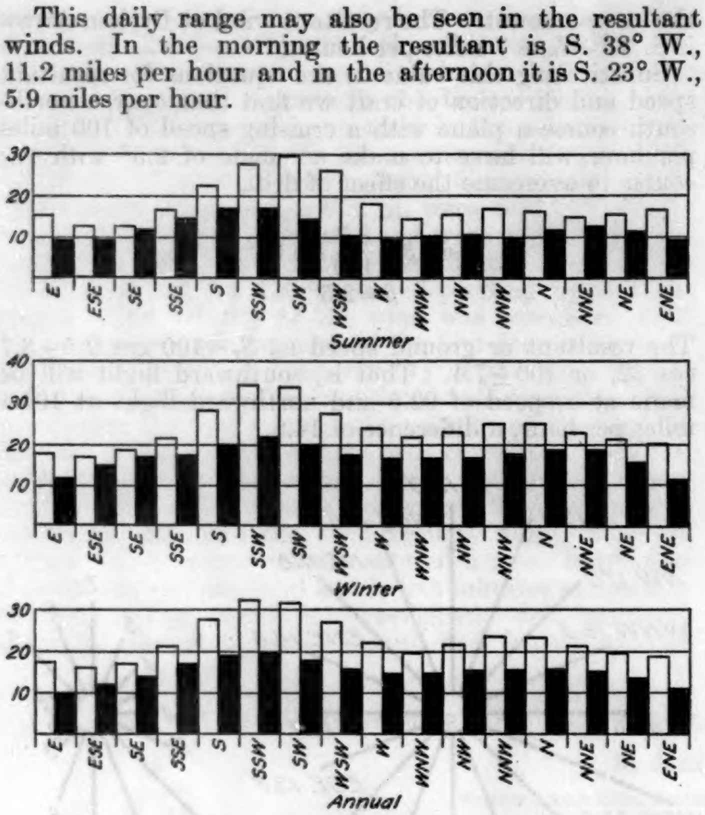


FIG. 3.—Average wind speed (m. p. h.) at 1,600 feet. Clear columns, 7 a. m., shaded columns, 3 p. m.

Winds from every direction are retarded during the day as shown by the seasonal and annual means in Figure 3. The greatest range occurs with the strongest winds, namely, those of the southwest quadrant. This is not because of slower speeds during the day but because the night winds from this quarter rise far above the average in speed. In summer, SSW. to WSW. winds vary from 28 miles per hour in the morning to 14 miles per hour in the afternoon; in winter, from 32 miles per hour in the morning to 20 in the afternoon.

The reason for the much stronger nocturnal free-air winds from the southwest is to be found in the vertical distribution of temperature. If the lapse rate exceeds the adiabatic rate the upper air, having a lower potential temperature, has a tendency to fall; mixing takes place and there is little stratification.

In a paper on "The relations between free-air temperatures and wind directions" Mr. Gregg has shown (*3*) that for the stations Drexel, Nebr., and Ellendale, N. Dak., the greatest lapse rate from the surface to the 500-meter level occurs in north and northwest winds and the least in SSW. to WSW. winds. Presumably much the same conditions hold for the southern Plains States.[3]

Southwest winds are therefore largely free from turbulence during the night and the free-air wind attains a high velocity with only a slight drag on the surface air. Conversely north winds, having a high lapse rate, undergo considerable mixing even at night with the result that strong winds are much less frequent.

These facts are emphasized by Figure 4, which gives the percentage frequency of strong winds occurring at flying levels in the morning. It will be noted that 78 per cent of all winds of 30 miles per hour or more and 88 per cent of all 40-mile winds, occur in the morning. This graph shows the very unequal distribution of strong winds from different directions. Most of them come from SSW. and adjacent directions, a moderate number from N. and NNW., while almost none comes from ESE. or WNW.

Ordinates on this graph show the frequency from each of the 16 points, while the total percentage for different speeds is given in the inset table. For instance, 30-mile winds occur in the morning 37 per cent of the time; they come from the one direction, SSW., 11 per cent of the time; from the three directions, south to southwest, 24 per cent; and from all other directions 13 per cent.

Forty-mile winds are half as frequent as 30-mile winds; they come from the SSW. alone 7 per cent of the time, from south to southwest 15 per cent, and from all other directions only 4 per cent. The preponderance of SSW. continues to increase with 50 and 60 mile winds; more than half of them being from this direction.

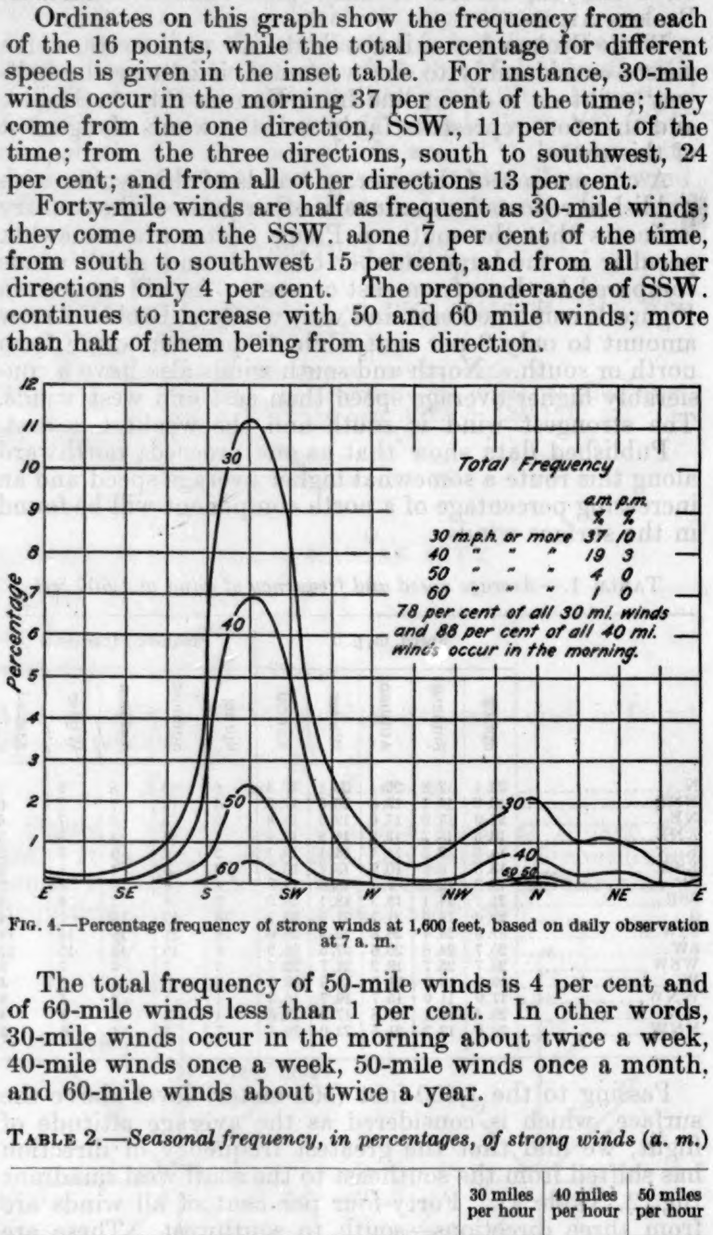


FIG. 4.—Percentage frequency of strong winds at 1,600 feet, based on daily observation at 7 a. m.

The total frequency of 50-mile winds is 4 per cent and of 60-mile winds less than 1 per cent. In other words, 30-mile winds occur in the morning about twice a week, 40-mile winds once a week, 50-mile winds once a month, and 60-mile winds about twice a year.

TABLE 2.—*Seasonal frequency, in percentages, of strong winds (a. m.)*

	30 miles per hour	40 miles per hour	50 miles per hour
Spring	46	26	7
Summer	31	13	1
Autumn	36	20	3
Winter	36	19	6

As to the seasonal frequency of strong winds, spring stands preeminent; the least is of course in summer; autumn and winter are near the annual average (see Table 2).

March is the windiest month. The aviator should be warned to beware the winds of March. They are the "roaring forties"; the most frequent directions, south to southwest, have an average speed of 41 miles per hour.

Summer offers the best opportunity for selecting a favorable flying level. On account of the small average speed and diurnal range, a high altitude, probably around 3,000 feet, will occasionally be found most

[3] The same relationship between lapse rates in the lowest levels and surface wind directions is found in this region, although the variation is somewhat less pronounced. As at Drexel and Ellendale, the largest differences occur in winter and the smallest in summer.—*W. R. G.*

favorable. For while it frequently happens at all times of year that there is a layer of strong wind between 1,500 and 2,000 feet, with weaker winds above and below, the decrease aloft is generally small except in summer. In winter and spring the least resistance will generally be met by flying as low as practicable.

In conclusion it may be said that the southern plains States offer a favorable field for flying activities. The country is open and mostly free from mountains. Visibility, the most important meteorological element in flight, is generally satisfactory. On the visibility scale, running from zero for dense fog to 9 for perfectly clear air, the visibility most frequently recorded is 7. As an example of excellent visibility it may be cited that a pilot balloon at Broken Arrow was followed with two theodolites to a distance of more than 50 miles, and when the balloon disappeared it was less than 6° above the horizon.

Dense fog is the most serious obstacle but interruption of flight by dense fog in this region is very infrequent. Thunderstorms are a serious handicap; they cause delays by compelling the aviator to fly around them; statistics show, however, that thunderstorms are less frequent in this region than in some other States except perhaps in May and June. Low clouds and rain present the most frequent unfavorable condition, and often necessitate flying near the ground.

The schedule of the Air Mail for this portion of the route is so arranged as to gain the greatest benefit from the daily changes of wind; northward flight in the morning is frequently advanced by the prevailing strong south winds; southward flight is less frequently delayed in the afternoon because wind speeds are then at their lowest rates. The greatest percentage of delayed trips may be expected when southward trips are made in the early morning.

LITERATURE CITED

(1) RILEY, J. A.
1923. THE WINDS OF OKLAHOMA AND EAST TEXAS. Mo. Wea. Rev., 51: 448–455.

(2) GREGG, W. R. and VAN ZANDT, J. PARKER.
1923. THE WIND FACTOR IN FLIGHT: AN ANALYSIS OF ONE YEAR'S RECORD BY THE AIR MAIL. Mo. Wea. Rev., 51: 111.
1924. THE FREQUENCY OF WINDS OF DIFFERENT SPEEDS AT FLYING LEVELS BETWEEN NEW YORK AND CHICAGO. Mo. Wea. Rev., 52: 153.

(3) GREGG, W. R.
1924. THE RELATIONS BETWEEN FREE-AIR TEMPERATURES AND WIND DIRECTIONS. Mo. Wea. Rev., 52: 1–18.

THE CORRELATION BETWEEN SUN-SPOT NUMBER AND TREE GROWTH

By J. ARTHUR HARRIS

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There is at present evident, in both the scientific and the popular press, a widespread interest in the possible relationship between solar activity and terrestrial phenomena.

Such interrelationships, if they exist at all, can best be demonstrated and their intensity measured by the determination of the correlation between some measure of the sun's activity and terrestrial variables.

The only measure of solar activity available for a protracted period of time is that of the sun-spot relative numbers. The most usable measures of terrestrial phenomena which might possibly be influenced by solar variation are the instrumentally determined values of temperature, precipitation, barometric pressure, and other meteorological phenomena and the record of the rate of plant growth as embodied in the trunks of trees.

A review of the extensive literature on the supposed relationship between solar activity and climatic factors and plant activities falls quite outside the scope of the present note, which has for its purpose merely the presentation of the actual correlations between the annual means of the monthly observed relative sun-spot numbers (s) as given by Wolfer (*1*)[1] and the annual ring (r) measurements on trees from various parts of the world as given by Douglass (*2*).

Because of the great variability of both sun-spot numbers and ring diameters it is difficult to secure a system of grouping either variable which may not introduce an appreciable error into the end results. The coefficients of correlations, and the antecedent means and standard deviations, were computed from the original sun-spot numbers, s, of Wolfer and the ring measurements, r, of Douglass by the formula (*3*),

$$r_{sr} = [\Sigma(sr) / N - \bar{s}\,\bar{r})] / \sigma s\, \sigma r$$

without grouping of either of the variables. The coefficients are, therefore, numerically absolutely correct, barring the possibilities of arithmetical error which has not been detected in the checking of the coefficients.

[1] The observed, not the smoothed, numbers were invariably used.

The coefficients shown in the accompanying table[2] are generally low. Three of the fifteen values determined from the whole series of data are negative in sign. The ratios of the coefficients to these probable errors are over 2.00 in only 8 of the 15 cases.

TABLE I.—*Correlations between Wolfer's mean sun-spot relative numbers and tree-ring diameters as recorded by Douglass*

Series and locality	Period	Correlation and probable error $r \pm E_r$	r/E_r
I. Flagstaff, Ariz.	1749–1910	+0.099±0.053	+1.87
II. South of England	1859–1912	+.265± .085	+3.10
III. Outer coast of Norway	1828–1912	+.174± .071	+2.45
IV. Inner coast of Norway	1820–1908	−.126± .070	−1.79
V. Christiania, Norway	1820–1912	+.071± .070	+1.02
VI. Central Sweden	1820–1910	+.109± .070	+1.57
VII. South Sweden	1820–1910	+.159± .069	+2.30
VIII. Eberswalde, Prussia	1830–1912	+.487± .056	+8.64
IX. Pilsen, Austria	1830–1912	+.096± .073	+1.30
X. Southern Bavaria	1848–1911	+.241± .079	+3.04
XI. Old Norway trees	1749–1835	−.164± .071	−2.31
XII. Old Sweden trees	1749–1835	+.317± .065	+4.84
XIII. Windsor, Vt.	1749–1912	−.076± .053	−1.45
XIV. Oregon group	1749–1911	+.157± .052	+3.03
XVI. Sequoia (group of 1915)	1749–1914	+.010± .053	+0.19
I. As above	1749–1829	+.073± .075	+0.97
I. As above	1830–1910	+.160± .073	+2.19
XIII. As above	1749–1829	−.272± .070	−3.89
XIII. As above	1830–1912	+.057± .074	+0.77
XIV. As above	1749–1829	+.395± .064	+6.20
XIV. As above	1830–1911	+.143± .073	+1.97
XVI. As above	1749–1829	+.091± .075	+1.22
XVI. As above	1830–1914	−.078± .073	−1.07

There are, however, unmistakable evidences for a positive correlation between the two variables. While the coefficients are admittedly low, 12 of the 15 coefficients deduced for the series of data as given by Douglass are positive in sign. Of the eight values which are over twice

[2] The Series I–XVI correspond to the tables given in the appendix to Douglass's volume. The Series XV is omitted because it falls wholly outside the period of sun-spot record. The Series I, XIII, XIV, and XVI are treated both as entities and subdivided for reasons indicated in the text.

as large as their probable errors, all but one are positive. The average value of the 15 coefficients (regarding signs) is +0.1212. Furthermore, two of the negative coefficients (IV and XI) are based on measurements from the same general region and are deduced from data emphasized as far from satisfactory by Douglass himself. The third series which indicates a slightly negative relationship (XIII) is noted by Douglass as having apparently been subject to a profound change in environmental conditions during the course of development.

On the other hand it is interesting to note that the four longer series (I, XIII, XIV, XVI) which cover the entire period for which sun-spot numbers are available, and which in consequence should be expected to show the highest correlations, actually show some of the lowest coefficients available. These have been subdivided into two periods, with a view to determining whether the inferior accuracy of the sun-spot numbers in the earlier years might be the source of the lower correlations for the longer periods of time.

Since a number of the other series cover the period 1820–1830 to 1910–1920, these four series have been broken at the year 1830. The results appear in the lower portion of the table. Series VIII and XIV show at least an apparent strengthening of the correlation due to the division of the materials. Improvement is not evident in Series XIII and XVI.

In stressing the smallness of these (generally positive) values, it is proper to emphasize two points:

(*a*) The correlations are between the sun-spot numbers and the growth increments of the same year. It is conceivable that there may be an anticipation or a lag in the biological consequences if solar activity as expressed in sun-spot number can be regarded as a real cause.

(*b*) The coefficients are the raw values, uncorrected for the influence of secular change in growth rate. Correction has not been attempted because of the excessive labor of calculation when grouping of the data can not safely be attempted. Let t = time, s = sun-spot number, r = width of growth rings. The corrected value should be given by the partial correlation coefficient between sun-spot numbers and tree ring dimensions for constant time, i. e.,

$$_{t}r_{sr} = \frac{r_{sr} - r_{st}r_{rt}}{\sqrt{1-r_{st}^2}\sqrt{1-r_{rt}^2}}$$

Now for data extending over a reasonably long period of time r_{st} should approach 0. General botanical experience would lead us to expect that r_{rt} will be negative in sign. Inspection of the formula will, therefore, suggest that the usual effect of correction will be to raise the values of the coefficients as given here.

Taken as a whole these coefficients indicate a low positive correlation between sun-spot number and tree growth. The relationship is by no means so intimate as many writers imply.

LITERATURE CITED

(*1*) WOLFER, A.
1902. Mo. Wea. Rev., 30: 171–176.
1920. Mo. Wea. Rev., 48: 459–461.

(*2*) DOUGLASS, A. E.
1919. CLIMATIC CYCLES AND TREE GROWTH. Publ. Carnegie Inst., Washington, 289, 1919.

(*3*) HARRIS, J. ARTHUR.
1910. Amer. Nat. 44: 693–699.

NOTES, ABSTRACTS, AND REVIEWS

TABLES FOR COMPUTING HARMONIC ANALYSIS

For students in meteorology, physics, engineering, economics, and other branches of science who find it necessary to compute periodograms, Fourier series, or harmonic analyses in other forms, there are now available Dr. Leo W. Pollak's *Rechentafeln zur Harmonischen Analyze* (published by Johann A. Barth, Leipzig). These tables will doubtless facilitate harmonic analysis fully as much as do the well-known Crelle Rechentafeln for multiplication and division.

The harmonic tables are in quarto form of about the same size and general external appearance as the Crelle tables.

Twelve pages of printed German text mention the purposes and advantages of tables for harmonic calculations, citing other publications and discussing the arrangement of the tables in two parts, I and II, with comments on the accuracy and verification of all computations.

Six additional pages, also in German, give general and detailed explanation of the use of the tables, with citations to the literature, concluding with the detailed computation of five examples of single wave forms by mental arithmetic as well as with the aid of computing machines. One example explains how a single higher harmonic (fifth) may be found.

Two of the examples show abridgments of the computations: First, when the considerable number of phase values (35) is odd, and, second, when the relatively large number (32) is divisible by four.

The reviewer can only remark that for a great number of possible users the value of the table would be much enhanced if the text accompanying them were printed in full in the English as well as the German language.

The tables are unique in a typographic sense, because printed from phototyped plates of hand-written original copies.

In problems of the harmonic analysis we must evaluate the amplitude of sine and cosine functions for elemental wave forms having observed or assigned values of the function at widely varying numbers of equidistant phase intervals.

Table 1 provides for every integral number of equidistant intervals from 3 to 40, inclusive, for each of which are tabulated the values of

$$iz = \frac{360^\circ}{n} z \Big]_{z=0}^{z=(n-1)}$$

The natural and the logarithmic sine and cosine of iz are also given and where required a reference to the page in Table 2 where products are to be found.

Table 2 comprises 120 pairs (pages). Pair 6, for example, is headed,

$$\text{Sin } 38^\circ\ 34'\ 17''.14 \cos 51^\circ\ 25'\ 42''.86 = 0.6234898$$

The table gives, to six significant figures, the products of the above number by all numbers from 1 to 1000, tabulated in all respects similar to the well-known Crelle tables. Two pages are obviously required.

A computer must of course become familiar with the requirements of the Fourier analyses and attain some proficiency in the use of these tables before their full value is realized.—*C. F. Marvin.*

THE SEVERE WINTER OF 1925–26 IN EUROPE

[Translated and slightly condensed from two notes by Charles Rabot in *La Nature*, January 16, 1926, Supplement, p. 17]

Floods in Europe.—The opening of December was marked in France and in northern and central Europe by very severe cold, with heavy snowfall, followed in France and central Europe by melting and heavy rains. Serious floods resulted, at certain points assuming truly catastrophic proportions. The regions most affected were the lowland of the Meuse, the region of the Lys, and the Escaut, and the valleys of the Oise and the Aisne. The rise in the Meuse was appreciably higher than that of 1910; the industrial towns in its valley, between Sedan and Givet, were severely affected, especially Givet, where the bursting of a dike caused the sudden flooding of fully a quarter of the town. In Belgium, the towns of Dinant, Namur, and Liege were flooded. The inundation was equally heavy in the valley of the Sambre, in the Charleroi Basin, and the Escaut Valley. The Oise rose higher than in 1910, and did particular damage to the villages of Compiegne and Creil. The Therain, an affluent of the Oise, flooded Beauvaise and the surrounding regions. The Aisne overwhelmed the low parts of Rethel and the city of Soissons. Holland was still more affected, on account of the simultaneous rise of the Rhine and the Meuse, which caused bursting of dikes and the inundation of vast extents of country.

In Normandy, the village of Caen was hard hit by the rise of the Orne coincident with the backing up of a high tide. The Saone likewise rose abnormally. Severe floods are reported also from the Rhine Valley and north Germany.

The winter in Scandinavia.—In north Europe the cold appeared very early this season and with abnormal intensity. From Norway also come reports of a particularly severe winter.

In Sweden on the 20th of October a remarkable drop in temperature was observed, when −24° C. was registered.

At Oslo, in southern Norway, November opened with very heavy snowfall, which, continuing during several days, interrupted communication in most districts. Throughout the month temperatures remained notably below normal, and since the beginning of December this departure has been increased. On December 1 at 8 a. m. in Oslo, −16.8° C. was recorded; at Roros −28° C.; in much of the country about the Norwegian capital veritable polar temperatures occurred, reaching as low as −40° C.

Likewise in Denmark temperatures were abnormally low; at 8 a. m. on December 1, values below freezing were experienced over the whole country. In Jutland the thermometer went to −15° C. On the 4th, several fjords on the east coast of that peninsula were already clogged with thick ice. In short, since the middle of the autumn a régime of cold has dominated Scandinavia and has persisted with abnormal vigor, recalling that of the hard winter of 1879.—*B. M. V.*

OBSERVED SUNSPOT REALTIVE NUMBERS—WOLFER

The table below contains the final and revised relative sunspot numbers for the years 1920–1924, according to Wolfer, who has kindly supplied them to the journal Terrestrial Magnetism and Atmospheric Electricity, in which they appear in the June, 1925, issue.

These numbers are to replace the provisional numbers published in the Monthly Weather Review for January, 1923, page 29.—*A. J. H.*

Observed sunspot relative numbers—Wolfer

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1920	51.1	53.9	70.2	14.8	33.3	38.7	27.5	19.2	36.3	49.6	27.2	29.9	37.6
1921	31.5	28.3	26.7	32.4	22.2	33.7	41.9	22.8	17.8	18.2	17.8	20.3	26.1
1922	11.8	26.4	54.7	11.0	8.0	5.8	10.9	6.5	4.7	6.2	7.4	17.5	14.2
1923	4.5	1.5	3.3	6.1	3.2	9.1	3.5	0.5	13.2	11.6	10.1	2.8	5.8
1924	0.5	5.1	1.8	11.3	20.8	24.0	28.1	19.3	25.1	25.6	22.5	16.5	16.7
1925	3.2	21.8	18.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

DETERMINING THE TIME OF MOONRISE AND MOONSET

Referring to the article entitled "A Short Method of Determining the Time of Moonrise and Moonset" in the October, 1925, issue of the Monthly Weather Review, it is thought that the following method may prove easier to understand than the method described in the article. It has been in use since 1918 at the Macon, Ga., office of the Weather Bureau, and found simple in practice.

First, Auxiliary Table A, Latitude Correction, was copied on the upper end of a card. Next, a table called "B" was made just below Auxiliary Table A. This new table is the result of adding Auxiliary Table B to the correction for local mean solar time. For example, longitude correction for a difference of 20 minutes according to Auxiliary Table B is +5. This was changed to +40 by adding the difference (+35 min.) between local mean solar time and seventy-fifth meridian time. In the same way all the corrections in Auxiliary Table B were changed.

When the two tables are used the moonrise or moonset can be found in about one minute.

Reasoning used.—Work from latitude 35°, Macon latitude 32° 50′.

Moonrise	Lat. 30°	Lat. 35°	Difference in minutes	Difference by Table A	Lat. 35° 50′	Correction Table B	Result
1926							
Jan. 1	19 25	19 15	10	4	19 19	+48	20:07
Jan. 2	20 18	20 09	9	4	20 13	--------	--------

Difference between 2 days=54.
54 according to Table B gives +48.
Result 20:07, is 8:07 p. m., January 1, 1926.

What actually appears on paper.—

Jan. 1 19 19+48 20:07
2 20 13

54

Jan. 2 20 13+48 21:01
3 21 07

54

Jan. 3 21 07+48 21:55
4 22 01

54

Etc.— *Harry Raynes.*

Mr. Raynes's method of computing moonrise and moonset is undoubtedly correct and clear-cut. There is no criticism except that "what actually appears on

paper" is too much for speed. By count, he is listing 18 figures per date in his computation. If he will set down the figures by the "column d" method, and use the same card he is now using, he will find that never more than 8 figures per date are required. He will also find that the entire month of 60 computations requires not over 30 minutes to complete.

It may be mentioned incidentally that the "Correction Card" method, noted and illustrated in the final paragraph of the October article, while not quite so easy to learn, has a speed of 60 computations in 15 minutes.—*F. N. Hibbard.*

METEOROLOGICAL SUMMARY FOR BRAZIL, DECEMBER, 1925

By J. DE SAMPAIO FERRAZ

The Meteorological Office, Rio de Janeiro

Circulation gauged by the frequency of anticyclones was more active this month. Five of these systems visited the country with tracks as irregular as in the previous month but a little less to the south.

The tracks were abnormal on account of the occasional expansion of the continental LOW and sudden passage of the high latitude depressions. In Brazilian charts we very frequently see the areas of high pressure deformed, checked, or thrown aside of their usual paths by the depressions. November and December HIGHS were victims of such action. In the latter month the continental LOW was particularly active from the 17th to the 23d and from the 27th to the 31st.

Generally rainfall was irregular throughout the country, but much more plentiful in the south and center than in the north.

The weather in Rio de Janeiro was warm and fair, with unusual excess of sunshine. On the 24th the city was struck by a high wind from SSE. with stiff gusts of 22 meters per second.

Crops generally did well, but cane in the north still suffering from lack of rain.

As this note is being released, 21st of January, rain continues very scarce in the northeast. Precipitations in normal years should begin in January in this region. If they continue absent, a serious drought may set in. The general aspect of daily charts indicate still a southern run of anticyclones, which is an ominous sign.

BIBLIOGRAPHY

C. FITZHUGH TALMAN, in Charge of Library

RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies.

Alfani, Guido.
Letture pireliometriche eseguite nel periodo giugno 1915-dicembre 1916. Firenze. 1917. 43 p. plates. 24 cm. (Pubb. Osserv. Ximeniano dei PP. Scolopi, Firenze. Num. 123.)
Letture pireliometriche eseguite nel periodo gennaio-dicembre 1917. Firenze. 1917. 51 p. plates. 24 cm. (Pubb. Osserv. Ximeniano dei PP. Scolopi, Firenze. Num. 125.)
Les observations pyrhéliométriques au moyen du pyrhéliomètre enregistreur de Gorczynski, et du pyrhéliomètre de Ångstrom. (Juin-juillet-août 1925.) Firenze. 1925. 20 p. plates. 24½ cm. (Pubb. Osserv. Ximeniano dei PP. Scolopi, Firenze. Num. 132.)
L'Observatoire Ximénien et son matériel scientifique. Les pyrhéliomètres à compensation électrique de Ångstrom et enregistreur de Gorczynski. Firenze. 1925. 11 p. plates. 24 cm. (Pubb. Osserv. Ximeniano dei PP. Scolopi, Firenze. Num. 130.)

American automobile association.
Snow removal. [2d ed. Washington. 1925.] 32 p. illus. 30½ cm.

American geophysical union.
Sixth annual meeting. Transactions. April 30 and May 1, 1925. Washington. 1925. 80 p. figs. 25 cm. (National research council. Bulletin. v. 10, pt. 3, July, 1925. No. 53.)

Angenheister, G.
Die Laufzeit des Schalls für grosse Entfernungen. p. 314-327. figs. 23 cm. (Zeitsch. f. Geophys., Jahrg. 1, H. 7.)

Boerema, J.
Regenval in Nederlandsch-Indië (Rainfall in the Netherlands Indies). Deel 2. (vol. 2.) Kaarten van den gemiddelden jaarlijkschen en maandelijkschen regenval op Java en Madoera, met een kaart der regenstations. (Maps of the mean yearly and monthly rainfall on Java and Madoera, with a map showing the position of the rainfall stations.) Weltevreden. 1925. maps. 40 cm. (K. Mag. en met. observ. Batavia. Verhand. No. 14.)

Coyecque, Marcel.
Notions de météorologie générale et nautique et éléments d'océanographie, à l'usage des officiers de marine et des candidats aux examens de la marine marchande. Paris. 1925. xviii, 383 p. figs. plates. maps. 23 cm.

Fickeler, Paul.
Der Altai, eine Physiogeographie. Gotha. 1925. viii, 202 p plates (part fold). 28 cm. (Dr. A. Petermanns Mitteilungen. Ergänzungsheft Nr. 187.)

Ficker, H. v.
Temperaturgradienten bei Föhn. p. 526-532. figs. 25½ cm. (Sitzungsb. preuss. Akad. der Wissensch. 30. 19. Nov., 1925.)
Untersuchungen über Temperaturverteilung, Bewölkung und Niederschlag in einigen Gebieten des mittleren Asiens. p. 351-400. figs. 25 cm. (Geografiska annaler, H. 4, 1923.)

Fontseré, Eduard.
Atlas elemental de núvols publicat a utilitat dels observadors de la xarxa meteorològica Catalana. . .amb un pròleg del E. Delcambre. Barcelona. 1925. 50 p. illus. plates. 28½ cm. [Text in Catalonian and French. French translation by Ph. Wehrlé.]

Frostiana: or, A history of the River Thames in a frozen state; with an account of the late severe frost; and the wonderful effects of frost, snow, ice, and cold, in England, and in different parts of the world; interspersed with various amusing anecdotes. To which is added, the art of skating. London. 1814. xxii, 124 p. 19 cm.

Gessler, R.
Die Stärke der unmittelbaren Sonnenbestrahlung der Erde in ihrer Abhängigkeit von der Auslage unter den verschiedenen Breiten und zu den verschiedenen Jahreszeiten. Berlin. 1925. 27 p. tables. plate. 34½ cm. (Veröffentl. des preuss. met. Inst. Nr. 330. Abhandl. Bd. 8, Nr. 1.)

Haeuser, Josef.
Der Hochwasserregen im bayerischen Donau- und Bodenseegebiet in den Tagen vom 29. bis 31. Juli 1924. München. 1925. 42 p. plates (part fold.). 34½ cm. (Veröffentl. Bayer. Landesstelle für Gewässerkunde.)
Niederschlagsmessungen in unbewohnten Hochlagen der bayerischen Gebirge. München. 1925. 14 p. illus. 34 cm. (Veröffentl. Bayer. Landesstelle für Gewässerkunde.)

Harmer, Paul M.
Prevention of crop injury by windstorms on muck land. A discussion of the use of water, heavy rolling and windbreaks in the prevention of crop destruction by winds on muck land. p. 83–86. 23½ cm. (Mich. state coll. Agric. exper. sta. Quart. bull. v. 8, No. 2, Nov., 1925.)

Hellmann, G.
Über die Wetterlage bei guter Fernsicht von Bergeshöhen. p. 533–538. 25½ cm. (Sitzungsb. der preuss. Akad. der Wissensch. 30. 19. Nov. 1925. Sitzungsber. phys.-math. Kl. 12. Nov. 1925.)
Wasserhosen auf dem Atlantischen Ozean. p. 539–544. fig. 25½ cm. (Sitzungsb. der preuss. Akad. der Wissensch. 30. 19. Nov. 1925. Sitzungsber. phys.-math. Kl. 12. Nov. 1925.)

Henry, A. J., *& others.*
Weather and agriculture. Washington. 1925. p. 457–558. illus. 23½ cm. (U. S. Dept. agric. Separate from Yearbook 1924, No. 918.)

Maps showing the mean atmospheric pressure and wind direction and force over the China Sea for each month of the year. Published under the authority of H. E. the Governor of Hongkong. Hongkong. 1925. unp. maps. 52½ cm.

Mémery, Henri.
Contribution à l'étude des variations périodiques de la température. Leur cause probable. Paris. 1921. 5 p. 24 cm. (Rapport présenté au Congrès de Strasbourg de l'Assoc. française pour l'avance. des sci., lundi 26 juil. 1920.) (Année 1921.)

Nagaoka, Hantaro, & Ayabe, Naoshi.
On a microbarograph. Tokyo. 1923. p. 135–137. plates (fold.). 26 cm. (Inst. phys. & chem. research, Sci. papers. v. 1, June, 1923. No. 9.)

Patron, Luis Riso.
Diccionario jeográfico de Chile. Santiago. 1924. xxiv, 958 p. 27½ cm. [Clima, p. xxi-xxii.]

Patton, P.
Weather outlook for 1926. Bozeman. 1925. 6 p. 28 cm. (Montana agric. outlook. No. 11, Dec. 15, 1925.)

Polaczkówna, Marja.
Wahania klimatyczne w Polsce w wiekach średnich. Climatic variations in Poland during the middle ages. Lwów. 1925. 80 p. 29½ cm. (Prace geograficzne. Zeszyt 5.)

Pollak, Leo Wenzel.
Rechentafeln zur harmonischen Analyse. Leipzig. 1926. 23+ p. tables. 34 cm.

Root, Clarence J.
Some outstanding tornadoes. Springfield. [1926.] 13, 49 p. 27 cm. [Typewritten.]

Rouch, J.
Pour comprendre le ciel et l'atmosphère. Paris. 1925. 352 p. illus. plates. 18 cm.

Sarasola, Simón.
Los huracanes de las Antillas. Bogotá. 1925. vi, 173 p. illus. 30½ cm. (Notas geofísicas y meteorológicas. . . Observ. nac. de San Bartolomé de Bogotá. . . Núm. 2.)

Sarnetzky.
Die Staubanzahl und ihr Verhalten in der Luft. p. 569–576. illus. 34 cm. (Gesundheits-Ingenieur. München. 48. Jahrg. 45. Heft. 7. Nov. 1925.)

Schoonover, Warren R., *& others.*
Orchard heating in California. Berkeley. 1925. 69 p. illus. 23½ cm. (Univ. of Cal. Coll. agric. Agric. exper. sta. Bull. 398. Dec., 1925.)

Spitaler, Rudolf.
Die Ergebnisse der Terminbeobachtungen im Jahrfünft 1920–1924 und Übersicht der Beobachtungsergebnisse von 1905–1924. Prag. 1925. 38 p. 32 cm. (Veröffentl. des met. Observ. auf dem Donnersberge (Böhmen). Nr. 11.)

U. S. Dept. of Commerce & American engineering council.
Civil aviation. A report by the joint committee on civil aviation of the U. S. Department of commerce and the American engineering council. New York. 1926. xvii, 189 p. figs. 23½ cm.

Wegner, Rudolf.
Klimakunde. (Allgemeine Klimakunde und das Klima Deutschlands.) Leipzig. [1924.] 56 p. chart. 12 cm.

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RECENT PAPERS BEARING ON METEOROLOGY

The following titles have been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers and other communications bearing on meteorology and cognate branches of science. This is not a complete index of all the journals from which it has been compiled. It shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau.

American journal of science. New Haven. (5) v. 11. February, 1926.
Whitman, W. G. Elimination of salt from sea-water ice. p. 126–132.

Annalen der Hydrographie und maritimen Meteorologie. Berlin. 53. Jahrgang. November 1925.
Arzibyschef, S. Temperaturmessungen mittels Thermosäule. p. 364–367.
Schedler, A. Die Schwankungen der Zirkulation der Atmosphäre über den Nordatlantischen Ozean, dargestellt durch Häufigkeitswerte der Minima, und ihre Beziehungen zu den meteorologischen Elementen in Europa. p. 355–364.

Archives des sciences physiques et naturelles. Genève. v. 7. Novembre-décembre 1925.
Gautier, Raoul. À propos du centenaire des observations météorologiques homogènes à l'Observatoire de Genève. p. 363–367.

Discovery. London. v. 7. February, 1926.
Barfield, R. H. Wireless and the upper atmosphere. p. 62–64.

Ecology. Brooklyn. v. 7. January, 1926.
Cook, William C. Some weather relations of the pale western cutworm (Porosagrotis orthogonia Morr.). A preliminary study. p. 37–47.
Payne, Nellie M. The effect of environmental temperatures upon insect freezing points. p. 99–106.

Engineering news-record. New York. v. 96. February 11, 1926.
Burchard, E. D. 1925 drought breaks all records in southern Appalachians. p. 234–235.

Farm journal. Philadelphia. v. 50. February, 1926.
Hurd, Willis E. The "roll cloud." p. 133.

France. Académie des sciences. Comptes rendus. Paris. t. 182. 4 janvier 1925.
Bureau, R. La prévision du temps et la variation diurne des atmosphériques. p. 76–77.

Geographical review. New York. v. 16. January, 1926.
Lee, Willis T. An ice cave in New Mexico. p. 55–59.
Murphy, Robert Cushman. Oceanic and climatic phenomena along the west coast of South America during 1925. p. 26–54.

Great Britain. Meteorological office. Geophysical memoirs.
Sen, Sachindra Nath. On the design of the Kew pattern barometer. (No. 27. 1925.)
Durst, C. S. The doldrums of the Atlantic. (No. 28. 1926.)

Heating and ventilating magazine. New York. v. 23. January, 1926.
Greenburg, Leonard. Necessity for changes in the ventilation laws of the United States. p. 49–52.

Hemel en dampkring. Den Haag. 24 jaargang. 1926.
Cannegieter, H. G. Temperaturen aan den grond en in de hoogre niveau's bij vorstweer. p. 2–5. (Januari.)
E[verdingen], E. van. De ijsperiode in November en December. p. 10–12. (Januari.)
Nell, Chr. A. C. Een ballontocht onder merkwaardige meteorologische omstandigheden. p. 6–10. (Januari.)
Pinkhof, M. Wat er aan den watersnood vooraf ging. p. 33–38. (Februari.)

Journal of geography. Chicago. v. 24. February, 1926.
Shank, Marjorie Mae. A mid-western tornado. p. 60–67.

Journal of geology. Chicago. v. 34. January–February, 1926.
Plyler, E. K. The growth of ice crystals. p. 58–64.

Marine observer. London. v. 3. February, 1926.
Keeton, H. Local winds. p. 28–30.

Meteorologia pratica. Montecassino. Anno 6. Settembre–dicembre 1925.

Crestani, Giuseppe. Influenza che hanno sulla misura delle precipitazioni atmosferiche alcune alterazioni della bocca di cattura del pluviometro. p. 181–185.

Marini, L. La meteorologia marittima alla IIª assemblea generale dell' Unione geodetica e geofisica internazionale. (Madrid ottobre 1924.) p. 197–200.

Oddone, Emilio. Ecologia: A proposito di "Una previsione sull' entità del prodotto del mandorlo di un' annata in base all' andamento della temperatura dell' aria e delle precipitazioni nel trimestre gennaio–marzo . . ." p. 186–190.

Paoloni, B. Per un servizio di radio-meteorologia agraria. p. 201–208.

Rasetti, Gerardo. Organizzazione internazionale di un servizio di meteorologia medico sociale. p. 193–196.

Meteorologische Zeitschrift. Braunschweig. Band 42. November 1925.

Albrecht, F. Die Untersuchung der Kugeln von Sonnenscheinautographen. p. 443–446.

Danilow, L. Die Wetterwellen. p. 417–422.

Ficker, H. v. Alexander A. Friedmann. p. 440. [Obituary.]

Gockel, A. Messungen der elektrischen Leitfähigkeit der Atmosphäre in Locarno. p. 447–448.

Hartmann, Wilh. Über die Wirkung des Nipherschen Schutztrichters. p. 446–447.

Kähler, K., & Dorno, C. Messungen der elektrischen Raumladung der Atmosphäre in Davos. p. 434–439.

Milch, Wilhelm. Zur Kondensation des Wasserdampfes als Problem der meteorologischen Optik. p. 422–428.

Perlewitz, P. Zur doppelten Tagesperiode des Luftdrucks am Boden. p. 448–451.

Reich, Alois. Zur Entstehung der tropsichen Zyklone. p. 428–430.

Robitzsch, M. Das Stehenbleiben der Registrieruhren in der Kälte. p. 442–443.

Schostakowitsch, W. B. Die Durchsichtigkeit des Wassers in den Gewässern Ostsibiriens. p. 430–434.

Wegener, Alfred. Alfred Merz. p. 439–440. [Obituary.]

Nature. London. v. 117. 1926.

Cave, C. J. P. Weather prediction from observations of cloudlets. p. 48. (Jan. 9.)

Wright, C. S. Cosmic rays. p. 54–56. (Jan. 9.) [*Re* Millikan's discovery.]

Rothwell, P. Detonating meteors. p. 85–86. (Jan. 16.)

Schmidt, P. J. Phenological observations and results in Russia. p. 119–120. (Jan. 23.)

Wright, W. B. The German outwash terraces and the astronomical theory of the ice age. p. 113–114. (Jan. 23.)

The rainfall of dry periods in relation to water-power schemes. p. 176–177. (Jan. 30.)

Reid, G. Archdall. Weather prediction from observation of cloudlets. p. 158. (Jan. 30.)

Cave, C. J. P. Cirrus at a lower level than alto-cumulus. p. 199. (Feb. 6.)

Whytlaw-Gray, R. Smokes as aerial colloids. p. 201–202. (Feb. 6.)

Nature. Paris. 54 année. 9 janvier 1926.

Rolet, Antonin. Les froids de l'hiver et les insectes. suppl. p. 13–14.

Nature magazine. Washington, D. C. v. 7. January, 1926.

Talman, Charles Fitzhugh. Phantoms of the air. p. 39–41.

Physikalische Zeitschrift. Leipzig. 27. Jahrgang, No. 1. 1926.

Behounek, Franz. Zum Ursprung der durchdringenden Strahlung der Atmosphäre. p. 8–10.

Popular science monthly. New York. v. 108. March, 1926.

Carr, John. How to be a weather fan; a fascinating new radio hobby. p. 60–62.

Royal astronomical society of Canada. Journal. Toronto. v. 19. December, 1925.

DeLury, Ralph E. Sunspots and the weather. p. 293–298.

Ireton, H. J. Recent investigations on the auroral spectrum. p. 289–292.

Royal society of London. Proceedings. London. ser. A. v. 110. 1926.

Williams, Frank Archer. The effect of temperature on the viscosity of air. p. 141–167. (Jan.)

Jeffreys, Harold. On the formation of water waves by wind. (Second paper.)

Tyndall, A. M., & Grindley, G. C. The mobility of ions in air. Part 1. Negative ions in moist air. Part 2. Positive ions of short age. p. 341–358; 358–364. (Feb.)

Science. New York. v. 63. January 1, 1926.

Spillman, W. J. Influence of air and sunshine on the growth of trees. p. 18.

Scientific American. New York. v. 82. 1926.

Clarke, Nell Ray. Ice flowers. p. 106–107. (Feb.)

Cooling your house in summer. How a former chief of the Weather Bureau solved the problem of keeping the air in his home cool in hot weather and moist in winter. p. 160. (March.)

Millikan. R. A. Cosmic rays. Radiation 10,000,000 times the frequency of visible light has just been added to the growing gamut of ethereal waves. p. 149–150. (March.)

Società meteorologica italiana. Bollettino bimensuale. Torino. v. 44. Ottobre–dicembre 1925.

Alippi, Tito. Decentramento meteorologico e presagio regionale. p. 77–83.

Eredia, Filippo. Il Congresso internazionale di climatologia a Davos. p. 73–77.

Tycos-Rochester. Rochester, N. Y. v. 16. January, 1926.

Abbot, C. G. Solar variation and the weather. p. 30–31. [Repr. from Science.]

The evolution of the weather map. p. 15–16.

Houk, Ivan E. When the clouds burst. p. 21–23; 29.

Laskowski, B. R. A two-mile-high Weather Bureau office. p. 17–18.

Lloyd, Joseph R. America's severest cold wave. p. 25–29.

Van Cleef, Eugene. A radio opportunity. p. 5–6; 7.

Van Orman, W. T. Bumping the clouds in a racing balloon. p. 10–14. [Repr. Pop. mechanics.]

The weather and radio static. p. 8–9.

Vida agricola. Lima. v. 2. Julio 1925.

Fuchs, Federigo G. Las últimas lluvias y la ciencia meteorologica. p. 521–524.

SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING JANUARY, 1926

By HERBERT H. KIMBALL, Solar Radiation Investigations

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1924, **52**:42, January, 1925, **53**:29, and July, 1925, **53**:318.

From Table 1 it is seen that solar radiation intensities averaged slightly above January normals at Washington and Lincoln, and slightly below at Madison.

Table 2 shows that the total solar and sky radiation received on a horizontal surface averaged close to the January normal at Washington and decidedly below the normal at the other two stations.

Skylight polarization measurements were not made at either Washington or Madison on account of the presence of snow on the ground at both stations during most of the month.

TABLE 1.—*Solar radiation intensities during January, 1926*

[Gram-calories per minute per square centimeter of normal surface]

Washington, D. C.

Date	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass A. M.					Air mass P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Jan. 2	3.30	0.56	0.67	0.91	1.21						3.15
6	8.81						1.18	1.06			7.87
11	1.60	0.70	0.83	1.23							2.62
16	2.62		0.77	0.96							3.45
19	5.79	0.70	0.77	0.93	1.20		1.20				4.57
28	1.60	0.89	1.10	1.21	1.37		1.32				0.79
29	0.64		1.11	1.15	1.29		1.25				1.02
Means		0.71	0.88	1.06	1.27		1.24	(1.06)			
Departures		−0.03	+0.04	+0.06	+0.04		+0.02	+0.03			

*Extrapolated.

TABLE 1.—*Solar radiation intensities during January, 1926*—Con.

Madison, Wis.

Date	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass A. M.					Air mass P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Jan. 7	1.52	1.10	1.22	1.24							1.68
9	1.68	0.91	1.03	1.16	1.30						1.96
13	1.68			1.33							1.24
15	1.45	1.13	1.21	1.34				1.23			1.88
18	3.00							1.20			2.87
22	0.51		1.14	1.26	1.39			1.24	1.09		0.86
23	0.79	0.85	0.98	1.13							1.45
25	1.37							0.97			1.68
28	0.36	1.09	1.23	1.35	1.53			1.31			0.43
29	0.91		0.70	0.90	1.14						2.36
Means		1.02	1.07	1.21	1.34			1.19	(1.09)		
Departures		+0.05	−0.01	−0.03	−0.02			−0.03	−0.04		

Lincoln, Nebr.

Date	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
Jan. 11	1.60	1.16	1.27	1.35	1.54			1.40	1.26	1.15	1.09
13	2.49							1.22	1.11	0.99	3.81
14	3.81	1.06	1.19	1.32				1.34	1.20		4.17
17	3.30								1.02	0.88	4.57
18	3.15							1.09	0.99	0.96	4.37
22	0.58			1.16	1.11			1.06	0.89	0.73	1.24
23	1.78	0.93	1.08	1.22	1.37			1.18	0.90	0.83	2.87
24	2.06			1.13							1.68
29	3.15	0.94	1.02	1.18	1.39						4.37
Means		1.02	1.14	1.23	1.35			1.22	1.05	0.92	
Departures		+0.10	+0.11	+0.06	−0.02			+0.02	+0.01	+0.01	

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter of horizontal surface]

Week beginning—	Average daily radiation					Average daily departure from normal		
	Washington	Madison	Lincoln	Chicago	New York	Washington	Madison	Lincoln
1926	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
January 1	144	102	122	29	71	−9	−40	−67
8	165	166	162	65	80	+6	+14	−37
15	147	147	206	50	77	−21	−20	−4
22	201	192	223	71	108	+22	+6	−5
Deficiency since first of year on January 28						−14	−280	−791

A STUDY OF THE SMOKE CLOUD OVER WASHINGTON, D. C., ON JANUARY 16, 1926

By IRVING F. HAND

The smoke cloud which covered Washington, D. C., on January 16, 1926, furnished an excellent opportunity to study the effect of city smoke. Eye observation and actual quantitative measurements of atmospheric pollution were made at both the central office of the Weather Bureau, which is located about 2 miles west of the Capitol, and at the American University, about 3 miles northwest of the Weather Bureau. The former point is about 80 feet above sea level, while the latter is 300 feet higher.

The regular 8 a. m. dust count made at the university gave 876 particles per cubic centimeter, or about one-half the average for the month. The sky was cloudless, the winds light and variable, and visibility slightly above average, hills in Maryland 10 miles to the west being visible. With a minimum temperature of 23° F., householders not only stoked their fires earlier, but used larger quantities of fuel, both of which, together with the favorable meteorological conditions, added materially to the accumulation of smoke over the city.

By 10 o'clock the smoke had become so dense in the business section that artificial lighting was necessary in both office buildings and on the streets. At this time the smoke could be seen from the university campus rising above the city with a flattish and irregular dome-shaped head. Upon being apprised of the unusual conditions in the city, the writer at once went to central office, but unfortunately passed through the densest part of the cloud on the way.

A measurement made at central office at 11:20 a. m., or about an hour after the passage of the smoke cloud,

gave 6,552 particles per cubic centimeter. While this is less than the maximum obtained on April 7, 1925 (1), no doubt had a measurement been taken an hour earlier it would have yielded a much larger number of particles.

Although the actual number of particles obtained in the downtown section is nearly eight times that obtained at the surburban point, this does not tell the entire story. The count at the American University revealed a considerable portion of mineral matter and most of the soot particles were much smaller than the ones obtained later in the day. This is probably accounted for by the fact that the smoke particles obtained at the university were the laggards, or particles from smoke of previous days so tiny that they had not yet fallen to the ground.

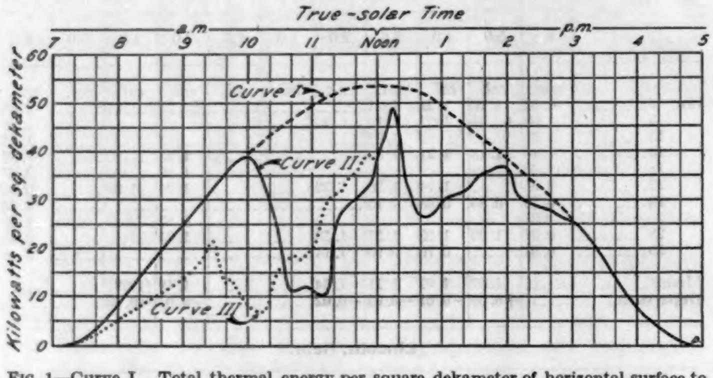

FIG. 1—Curve I. Total thermal energy per square dekameter of horizontal surface to be expected at the American University with a cloudless sky, January 16, 1926
Curve II. Actual thermal energy per square dekameter of horizontal surface received at the American University, January 16, 1926
Curve III. Actual thermal energy per square dekameter of horizontal surface received at the National Academy of Science Building, Twenty-first and B Streets NW., D. C., during the morning of January 16, 1926

A most objectionable feature of particles in fresh smoke is the fact that they are composed of from 20 to 40 per cent tarry products, when the smoke comes from plants not equipped with an effective smoke consumer—and practically no residences are so equipped. On the other hand, a well designed smoke consumer reduces the tarry composition to about 1 per cent.

The accompanying Figure 1 shows graphically the decrease in the total thermal energy received from the sun and sky on a horizontal surface at both the American University and at the National Academy of Science Building, Twenty-first and B Streets NW., as compared with a smoke-free sky. Comparison of Curves II and III shows clearly the passage of the cloud from the city to the university campus.

The intensity of thermal energy received on a horizontal surface at the American University at 11 a. m. was 11 kilowatts per square dekameter as compared with the 49 kilowatts that would have been received had the sky been free from smoke. Computed on the basis of a square mile, or 25,900 square dekameters, the energy received with a clear sky becomes 1,269,100 kilowatts, and for a smoky sky 284,900 kilowatts. Therefore the loss of energy per square mile was nearly 1,000,000 kilowatts per square mile, or sufficient energy to support 25 million 40-watt lamps.

Lieutenant Smirnoff of the Potomac Electric Power Co. informs me that at 11 a. m. on January 16 in what is known as the down-town section of Washington, covering about 3½ square miles, the electric load was 64,000 kilowatts, as compared with an average for this hour in January on clear days of 52,000 kilowatts.

Besides the loss in thermal solar energy due to the smokiness of the air over cities, perhaps a more serious loss is the almost complete elimination of ultra-violet radiation, which recent investigations have shown to be of great physiological importance.

The Washington smoke cloud of January 16, while unusual for this city, was no denser than that commonly found when light winds prevail in the business centers of large cities where bituminous coal is burned (2).

LITERATURE CITED

(1) Hand, Irving F.
1925. Effect of local smoke on visibility and solar radiation intensities. Mo. Wea. Rev., 53: 147–148.
(2) Kimball, Herbert H., and Hand, Irving F.
1924. Investigations of the dust content of the atmosphere. Mo. Wea. Rev., 52: 133. See especially "Dust ccunts away from Washington," pp. 138–139.

WEATHER OF NORTH AMERICA AND ADJACENT OCEANS

NORTH ATLANTIC OCEAN

By F. A. YOUNG

January is considered the stormiest month of the year over the North Atlantic and during the current month the number of days with winds of gale force not only exceeded the normal, as shown on the Pilot Chart, over the greater part of the ocean, but during the first and last decades the wind attained hurricane force over an unusually large area. The weather during the latter period was especially severe and was responsible for the large number of casualties reported, including the wreck of the *Antinoe*, *Laristan*, and a number of other vessels. Taken as a whole the month will be remembered as one of the most severe on record, and a number of trans-Atlantic vessels reported from 4 to 5 separate storms en route, covering practically the entire voyage.

As is often the case during protracted periods of stormy weather, fog was comparatively rare over the Grand Banks, the steamer lanes, and off the European coast, although unusually prevalent in the Gulf of Mexico, where it was reported on 6 days.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, 8 a. m. (seventy-fifth meridian time). North Atlantic Ocean, January, 1926*

Stations	Average pressure [1]	Departure	Highest	Date	Lowest	Date
	Inches		*Inches*		*Inches*	
St. Johns, Newfoundland	29.58	−0.37	30.10	17th	28.62	29th
Nantucket	29.97	−0.12	30.44	8th	29.38	28th
Hatteras	30.10	−0.02	30.48	29th	29.64	22d
Key West	30.09	0.00	30.24	1st	29.92	[2] 30th
New Orleans	30.13	+0.01	30.40	1st	29.76	31st
Swan Island	29.92	−0.06	30.00	[2] 23d	29.84	[2] 21st
Turks Island	30.11	+0.13	30.20	4th	29.94	14th
Bermuda	30.20	+0.07	30.48	17th	29.70	14th
Horta, Azores	30.08	−0.02	30.52	16th	29.52	9th
Lerwick, Shetland Islands	29.66	−0.05	30.47	13th	29.19	23d
Valencia, Ireland	29.68	−0.22	30.23	13th	28.83	31st
London	29.87	−0.13	30.33	12th	29.34	3d

[1] From normals shown on H. O. Pilot Chart, based on observations taken at Greenwich mean noon, or 7 a. m., seventy-fifth meridian.
[2] And on other dates.

Unusually low average pressure prevailed at the stations on the American coast north of Nantucket, as well as the coast of northern Europe. The average at Horta was near the normal, although winds of force 7 or higher

were reported on 13 days at that station, the maximum being south, force 9, on the 27th.

Charts VIII to XI show the conditions from the 28th to 31st, inclusive, and while it would be interesting to have presented charts for a number of other days, it was impracticable to do so on account of lack of space.

The month began with one depression over Newfoundland and a second central near 48° N., 30° W. The western LOW was of slight intensity, although from the 1st to 3d a few reports of moderate gales were received from vessels between the Bermudas and Nova Scotia. The eastern disturbance, which was off the coast of Scotland on the 3d and 4th was much more active, and on the first three days of the month moderate to strong gales prevailed over the eastern section of the steamer lanes, while on the 4th heavy weather was encountered over the greater part of the ocean west of the twentieth meridian, as well as off the coast of southern Europe.

On the 5th and 6th there was a well-defined storm area between the fortieth and fifty-fifth parallels, west of the forty-fifth meridian, where at times the wind attained hurricane force. On the 6th there was also a LOW near Father Point, and while at the time of observation, moderate weather prevailed along the American coast, westerly gales occurred later in the day off Hatteras.

On the 7th there was a slight depression in the Gulf of Mexico, and northerly winds of gale force were encountered in the western section. On the same day there were also LOWS central near St. Johns, Newfoundland, and Stornoway, Scotland, respectively, with gales over the greater part of the steamer lanes, as well as in the vicinity of the British Isles. On the 8th the Gulf depression was central near Charleston, and on the 9th off the coast of New Jersey. On the former date moderate gales were reported off Hatteras, while by the 9th the storm area extended along the coast between Charleston and Nantucket. On the 8th the LOW that was near St. Johns on the 7th, was central near 53° N., 38° W., while the European disturbance had moved but little, On that date strong westerly gales prevailed west of the thirty-fifth meridian and southerly winds of gale force were also encountered between the twenty-fifth meridian and the British coast.

On the 9th the greater part of the ocean east of the fifty-fifth meridian, between the thirty-fifth and fifty-fifth parallels, was swept by strong gales, which at times attained hurricane force. On the 10th the Atlantic coast disturbance of the previous day was about 5° east of St. Johns, and the eastern LOW near 50° N., 27° W., the weather conditions being similar to that of the 9th except that the two storm areas had merged and now extended as far west as the sixtieth meridian. The eastern LOW moved but little during the next 48 hours, but by the 11th the storm area had contracted considerably in extent and moderate weather was the rule west of the fortieth meridian, except for moderate northwesterly gales off the east coast of Florida, while the eastern section of the steamer lanes was storm swept as far south as the Azores. This disturbance continued to decrease in intensity and extent and by the 12th and 13th only scattered gale reports were received by vessels in the eastern part of the ocean.

On the 14th there was a small, but well-developed, depression between the Bermudas and Hatteras that moved northeastward along the coast, and on the 15th was central near Sable Island, while on both days gales prevailed near the respective centers. On the 14th and 15th gales were also reported by vessels in widely scattered locations in the middle and eastern sections of the steamer lanes.

By the 16th the western disturbance had moved off the limits of the chart, while the weather over the greater part of the ocean was about the same as on the 15th, except that a LOW developed near 50° N., 20° W., that moved steadily eastward, and on the 17th was off the coast of France where strong westerly gales prevailed.

The 18th was apparently the quietest day of the month, as only two reports have been received of gales on that date.

On the 19th there was a LOW over Nova Scotia and Maine with southerly gales as far south as the Bermudas, while moderate weather prevailed over the remainder of the ocean, except for a disturbance of limited extent near 50° N., 25° W.

On the 20th the western LOW was central about 10 degrees east of St. Johns with the eastern one about the same distance west of the west coast of Ireland, and vessels near the centers of both depressions reported moderate gales. By the 21st the western LOW of the 20th was central near 50° N., 30° W., and the eastern over Ireland, with gales prevailing over a limited area in the vicinity of the former.

On the 21st there was a depression in the western part of the Gulf of Mexico, where on that date and also on the 22d, moderate gales occurred. This LOW moved northeastward with extreme rapidity, and on the 22d was central near the south coast of Newfoundland; gales prevailed along the coast between Georgia and Nova Scotia, extending as far east as the Bermudas, while conditions in mid-ocean had changed but little since the 21st.

On the 23d the western disturbance was central about 10° east of St. Johns; it had increased tremendously in intensity and extent since the previous day, the storm area extending as far east as the thirtieth meridian. This was the beginning of a series of most disastrous storms that continued over the steamer lanes with very brief intermissions until the end of the month, and was responsible for a large number of marine disasters. On the 23d there was also a LOW over Ireland, with westerly gales in the southerly quadrants.

On the 24th Belle Isle was near the center of another disturbance with westerly gales between the thirty-fifth and forty-fifth parallels, while conditions along the steamer lanes on this date and the 25th did not differ materially from those of the 23d.

On the 26th the storm area was restricted to the region between the thirty-fifth and fiftieth parallels, east of the fortieth meridian. On the 26th there was also a slight depression central a short distance north of the Bermudas that afterwards developed considerably as it moved northward. The center of this LOW on the 27th was about 10° south of Halifax and on the 28th near Belle Isle. On both of these dates gales were encountered along the American coast between Hatteras and Halifax, while conditions over the greater part of the steamer lanes had moderated temporarily, although moderate westerly gales were encountered off the coast of Europe.

Charts IX to XI show the conditions for the period from the 29th to 31st, when unusually severe storms prevailed over the greater part of the steamer lanes, while, on the 29th, there was also a "norther" in the Gulf of Mexico.

OCEAN GALES AND STORMS, JANUARY, 1926

Vessel	Voyage		Position at time of lowest barometer		Gale began	Time of lowest barometer	Gale ended	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Highest force of wind and direction	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				Inches					
Patria, Fr. S. S.	Lisbon	New York	41 13 N.	32 04 W.	Jan. 1	7a., 1	Jan. 1	29.56	WSW	W., 10	WSW	W., 10	W.-WSW.
Lucellum, Br. S. S.	Newport News.	Hamburg	37 55 N.	56 40 W.	2	2p., 2	2	29.92	SW	W., 11	NW	W., 11	SW.-W.-NW.
Cripple Creek, Am. S. S.	Galveston	Liverpool	46 55 N.	30 07 W.	2	6a., 2	4	29.44	S	SSW., 11	SW	SSW., 12	S.-SW.
Maiden Creek, Am. S. S.	Greenock	Mobile	47 00 N.	16 05 W.	3	— 3	3	29.67	S	S., 8	W	—, 10	—.
Minnequa, Am. S. S.	Copenhagen	Boston	57 03 N.	26 10 W.	5	9a., 5	7	27.80	SW	SW., 8	WSW	SW., 12 [1]	—.
American Banker, Am. S. S.	London	New York	49 27 N.	20 30 W.	3	10a., 5	6	29.29	W	SSW., 10	NW	W., 12	SW.-NW.
Colorado Springs, Am. S. S.	New Orleans	Liverpool	36 40 N.	71 30 W.	6	3p., 6	8	29.77	NW	NW., 7	NNW	—, 8	NW.-NE.
El Sol, Am. S. S.	Galveston	New York	27 02 N.	89 20 W.	7	4p., 7	7	29.82	N	N., 7	N	—, 10	Steady.
Pres. Monroe, Am. S. S.	Mediterranean.	do	40 43 N.	43 10 W.	6	4p., 8	9	29.46	S	W., 10	NW	W., 10	S.-W.-NW.
Mayari, Br. S. S.	Boston	Cuba	37 30 N.	69 30 W.	8	5p., 9	10	29.72	E	W., 10	WNW	W., 10	W.-NW.
American Banker, Am. S. S.	London	New York	46 12 N.	42 05 W.	7	Noon, 9	10	28.85	WSW	WNW., 11	WSW	NW., 12	SW.-NW.-SSE.
Mijdrecht, Du. S. S.	Vigo, Spain	do	38 18 N.	31 56 W.	7	6a., 9	10	29.61	SW	SW., 8	WNW	NW., 10	SW.-W.-NW.
Incemore, Br. S. S.	Belfast	do	55 40 N.	15 42 W.	8	10p., 9	11	28.62	S	S., 12	S	S., 12	Steady.
Paris, Fr. S. S.	Havre	do	45 33 N.	42 10 W.	10	7p., 10	11	28.90	SSW	WSW., 10	NW	WSW., 10	—.
Glendoyle, Am. S. S.	Norfolk	Tampa	25 28 N.	80 00 W.	10	—, 10	11	30.07	NNW	NNW., 7	NNW	—, 8	NNW.-N.-NW.
Lucellum, Br. S. S.	Newport News.	Hamburg	47 24 N.	27 59 W.	6	5a., 11	11	28.80	SW	S., 12	WSW	S., 12	SW.-W.-SW.-S.
Mitra, Br. S. S.	Southampton	Philadelphia	45 50 N.	19 36 W.	11	8p., 11	12	29.16	SSE	SSE., 10	N	SSE., 11	SSE.-S.
Cabo Torres, Spain S. S.	Portugal	New York	36 00 N.	70 49 W.	14	8a., 14	14	29.48	SW	W., 10	NW	N., 10	NW.-N.
Nubian, Br. S. S.	New York	Liverpool	41 14 N.	62 57 W.	14	3p., 15	15	29.12	SW	WSW., 10	W	W., 11	WSW.-W.
Masconomo, Ger. S. S.	Danzig	Baltimore	49 00 N.	35 50 W.	17	8a., 17	18	29.56	SSW	WSW., 7	W	WNW., 10	—.
War Pathan, Br. S. S.	Rouen	Trinidad	49 13 N.	4 30 W.	17	8a., 17	17	29.23	WNW	WNW., 7	N	N., 9	WNW.-N.
West Kedron, Am. S. S.	Freetown	New York	40 15 N.	71 16 W.	18	4p., 18	19	29.36	S	S., 9	W	S., 9	S.-SW.-W.
Parthenia, Br. S. S.	Avonmouth	St. John, N. B.	50 22 N.	26 02 W.	19	8p., 19	21	29.49	NW	NW., 8	NW	NW., 10	—.
Chickasaw, Am. S. S.	England	Philadelphia	56 00 N.	29 21 W.	20	4a., 20	20	29.17	NW	N., 7	NW	—, 10	NW.-S.-WNW.
Baron Semphill, Br. S. S.	Cuba	Texas City	28 05 N.	92 30 W.	21	8a., 21	22	29.81	SSE	SSE., 7	NW	WNW., 9	SE.-S.-W.-N.
Carlier, Belg. S. S.	Antwerp	New York	35 18 N.	64 40 W.	22	4p., 22	23	29.70	SW	SW., 8	NNW	SW., 10	SW.-NW.-NNW.
Stuttgart, Ger. S. S.	Bremerhaven	do	42 00 N.	62 10 W.	24	3p., 22	24	28.99	SW	WNW., 11	WSW	WNW., 11	SSW.-NW.
Darian, Br. S. S.	Liverpool	Boston	49 03 N.	31 49 W.	22	6p., 22	26	28.65	WNW	WNW., 7	NW	—, 10	NW.-S.-NW.
Hatteras, Am. S. S.	Belfast	New York	45 00 N.	52 00 W.	23	4a., 23	24	28.85	NNW	NNW., —	WNW	—, 11	W.-WNW.
Gloria de Larrinaga, Br. S. S.	Liverpool	Galveston	47 20 N.	38 49 W.	23	9a., 23	26	28.89	SW	SW., 8	NW	—, 12	SW.-W.
France, Fr. S. S.	Havre	New York	48 00 N.	32 30 W.	23	8a., 23	26	29.38	SW	SW., 8	NW	SW., 12	—.
Mayari, Br. S. S.	Cuba	Boston	36 33 N.	70 50 W.	24	1p., 24	24	29.92	WSW	WNW., 10	NNW	WNW., 10	W.-NW.
Blijdendijk, Du. S. S.	Newport News.	Rotterdam	48 30 N.	24 16 W.	23	5p., 24	25	29.34	SSW	SW., 10	WSW	SSW., 10	SW.-W.
Hatteras, Am. S. S.	Belfast	New York	43 00 N.	54 06 W.	25	1a., 25	26	29.66	NW	NW., —	NW	—, 11	Steady.
Ampetco, Belg. S. S.	Baton Rouge	Antwerp	49 16 N.	31 02 W.	25	8a., 25	26	28.65	SSE	SSW., 11	WNW	SW., 11	SSE.-SW.-WNW.
Montpelier, Am. S. S.	Hamburg	New York	46 07 N.	32 10 W.	22	8p., 25	26	28.96	NW	SW., 10	WNW	SW., 12	SW.-S.-SW.
Masconomo, Ger. S. S.	Danzig	Baltimore	39 31 N.	61 20 W.	27	8a., 27	29	29.48	SE	S., 10	NW	W., 11	—.
Arminco, Belg. S. S.	Antwerp	Philadelphia	47 04 N.	34 00 W.	28	10p., 28	29	28.90	SSE	W., —	ESE	NW., 12	S.-SSE.-W.
El Mundo, Am. S. S.	Galveston	New York	25 18 N.	85 15 W.	28	1p., 29	29	29.92	NNE	NNE., 8	NNE	—, 8	Steady.
Sac City, Am. S. S.	Rotterdam	Boston	36 48 N.	55 48 W.	27	9a., 29	30	29.75	SW.	W., 10	NW	W., 10	SW.-W.
Montpelier, Am. S. S.	Hamburg	New York	44 00 N.	40 05 W.	29	7a., 29	Feb. 1	29.17	S	W., 8	NW	W., 11	S.-W.-NW.
Baltic, Br. S. S.	Liverpool	do	43 46 N.	48 10 W.	29	2p., 29	Jan. 31	29.17	WNW	NW., 6	WNW	—, 11	WNW.-W.
Bannock, Am. S. S.	Avonmouth	Baltimore	36 55 N.	36 30 W.	30	Noon, 30	Feb. 1	29.82	WSW	W., 10	NW	W., 10	WSW.-NW.
Seattle Spirit, Am. S. S.	Bremen	Philadelphia	42 50 N.	28 00 W.	29	7p., 30	Feb. 2	29.04	S	WNW, 10	WNW	W., 10	S.-SW.-WNW.
Arminco, Belg. S. S.	Antwerp	do	47 20 N.	37 00 W.	29	10a., 3	Feb. 1	28.64	NW	WNW., —	WNW	NW., 12	WNW.-NNW.
Spar, Du. S. S.	Swansea	Portland, Me	44 24 N.	31 30 W.	30	9a., 31	Feb. 1	28.74	W	W., 11	WNW	W., 11	Steady.
Lacuna, Br. S. S.	Curacao	England	47 30 N.	15 00 W.	30	10a., 31	Feb. 1	28.63	SSE	WSW., —	SW	SSW., 12	Steady.
NORTH PACIFIC OCEAN													
Eemdijk, Du. S. S.	Los Angeles	Balboa	15 00 N.	94 30 W.	Dec. 31	2p., 1	Jan. 1	29.85	E	N. 9	Variable	N., 9	N.-NW.-NE.
Venezuela, Am. S. S.	Balboa	Los Angeles	19 54 N.	106 01 W.	Jan. 1	9 a.	1	29.81	E	SE., 10	NW	SE., 10	SE.-S.
Kongosan Maru, Jap. S. S.	Kobe	Seattle	44 45 N.	164 30 E.	Dec. 31	Noon, 1	Jan. 2	29.03	NE	WSW., 10	NNW	WSW., 10	SSE.-SSW.-W.
Pres. Polk, Am. S. S.	Honolulu	Shanghai	31 66 N.	164 43 E.	Jan. 3		5	29.66	WSW	WSW., 4	WNW	W., 9	SW.-WNW.
West Jessup, Am. S. S.	Columbia River.	Yokohama	41 21 N.	145 33 E.	3	2 pl, 3	5	29.32	WSW	WNW., 7		W., 10	WSW.-WNW.
Gyokoh Maru, Jap. S. S.	Osaka	Puget Sound	46 18 N.	167 38 E.	3	Noon, 4	6	28.58	ESE	E., 10	N	E., 11	E.-ENE.
Tuscaloosa City, Am. S. S.	Manila	San Francisco	43 12 N.	167 50 W.	4	7 a., 4	5	28.58	WNW	WNW., 8	NNW	W., 10	WNW.-W.
Tamaha, Br. S. S.	Shanghai	do	40 05 N.	172 20 E.	4	2 p., 4	6	28.95	WSW	W	NW	W., 10	WSW.-W.
West Carmona, Am. S. S.	San Francisco	Yokohama	31 29 N.	171 34 W.	4	Noon, 5	6	29.62	SSW	W., 8	NW	WNW., 10	SSW.-W.-NW.
West Himrod, Am. S. S.	Kobe	Seattle	40 49 N.	152 08 E.	6	Noon, 6	7	29.05	WNW	WNW., 7	NW	W., 10	WNW.-W.-NW.
Africa Maru, Jap. S. S.	Victoria	Yokohama	48 56 N.	169 00 E.	8	Noon, 8	9	29.03	NE	NE., 8	NW	N., 9	NE.-N.
West Faralon, Am. S. S.	Manila	San Francisco	38 00 N.	176 45 W.	8		10	29.22	W	W., 8	W	W., 8	Steady.
Manchuria, Am. S. S.	San Francisco	New York	14 50 N.	95 50 W.	9	4 a., 9	10	29.91	ENE	ENE., 7	NNW	N., 9	ENE.-N.
West Jester, Am. S. S.	do	Yokohama	30 48 N.	152 35 E.	9	4 p., 10	12	29.43	S	WNW., 11	NNW	WNW., 11	S.-W.-NNW.
West Cactus, Am. S. S.	Balboa	San Pedro	15 36 N.	95 32 W.	10		11	30.05	NNW	NNW., 7	NE	NNE., 9	NNW.-NW.
Tenpaisan Maru, Jap. S. S.	Miike, Japan	Grays Harbor.	47 20 N.	170 30 E.	10	4 a, 12	13	28.90	E	N., 8	NW	N., 8	NNE.-N.
West Carmona, Am. S. S.	San Francisco	Yokohama	32 15 N.	160 55 E.	14	4 a., 15	15	29.69	SSW	SSW., 8	N	SSW., 9	SSW.-NW.-N.
Harold Dollar, Br. S. S.	Shanghai	Manila	47 02 N.	165 37 E.	14	6 a., 15	15	29.00	SSE	SE., 9	W	SE., 9	SSE.-W.
Aorangi, Br. S. S.	Victoria	Honolulu	40 35 N.	138 45 W.	16	3 a., 16	17	29.60	WNN	WNW., 10	WNW	WNW., 10	Steady.
Harold Dollar, Br. S. S.	Shanghai	Manila	49 00 N.	177 00 W.	18	8 p., 18	19	28.82	NW	W., 9	WSW	W., 9	NW.-W.
Empress of Asia, Br. S. S.	Yokohama	Vancouver	36 23 N.	142 51 E.	20	Noon, 20	23	28.75	NW	N., 8	WSW	WNW., 10	NW.-WSW.
Harold Dollar, Br. S. S.	Shanghai	Manila	45 02 N.	136 25 W.	22	10 p., 25	25	29.50	SSW	SW., 9	S	SE., 10	SE.-S
Erie Maru, Jap. S. S.	Japan	Columbia River.	37 24 N.	144 09 E.	20	4 a., 21	26	29.10	NW	NW., 10	NW	NW., 10	NW.-WNW.
Chincha, Am. S. S.	Baltimore	Los Angeles	13 28 N.	94 26 W.	22	4 a., 23	23	29.85	N	N., 8	NNE	N., 9	
India Arrow, Am. S. S.	Tsingtao	San Pedro	38 30 N.	157 15 W.	23	25	25	28.84	WSW	SSW	NW	SSW., 12	
New Britain, Am. S. S.	San Francisco	Balboa	14 53 N.	98 44 W.	26	2 a., 27	27	29.94	ENE	NE., 9	NNW	NE., 9	NE.-NNW.
Yankee Arrow, Am. S. S.	Wuhu	San Francisco	38 28 N.	145 06 W.	25	26	29	28.83	WSW	SW., 10	SW	WSW., 11	SW.-WSW.
Carriso, Am. S. S.	Columbia River.	Honolulu	35 10 N.	142 38 W.	29	4 a., 30	30	29.60	W	W., 9	NW	W., 11	W.-NW.-W.
Dilworth, Am. S. S.	Cebu	Portland	41 55 N.	178 30 E.	27	Noon, 30	31	29.01	NW	WSW., 8	WSW	W., 10	W.-WSW.
West Cajoot, Am. S. S.	Hongkong	San Francisco	34 14 N.	167 50 E.	29	4 a., 30	31	29.72	W	W., 8	NW	W., 10	W.-NW.

[1] Velocity of wind estimated 120 miles per hour.

NORTH PACIFIC OCEAN

By WILLIS E. HURD

Extraordinary conditions of pressure prevailed over a considerable part of the North Pacific Ocean during January, 1926. Abnormally high pressure covered the China coast and adjacent waters. Cyclonic storms entering the ocean from Japan were strengthened by the considerable gradient existing between their centers and the neighboring anticyclone, and in consequence developed more than usual energy. The anticyclone off the coast of California was weaker than normal. It persisted in a more or less restricted area during about three-fourths of the month, until by the 25th little was left of it except a meager coastal belt off extreme southern California and the adjacent peninsula, and even this had disappeared by the 31st.

The Aleutian LOW probably never in recent years was so persistent and highly developed as in this month. Its center fluctuated considerably along the fiftieth parallel, but over its entire usual area pressure continued unbrokenly low, and on several days cyclonic conditions prevailed over the whole sea between northern Japan and British Columbia. The average center was located near Dutch Harbor, where the unprecedentedly low mean of 29.06 inches was found, this being more than a half inch below the normal. Even as far north as Nome the negative pressure departure was as great as 0.38. At Dutch Harbor, St. Paul, and Kodiak no pressure readings as high as 30 inches were recorded, and the same was true of Nome, except on the 21st and 22d.

The following table illustrates these conditions:

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level at indicated hours, North Pacific Ocean, January, 1926*

	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inches*	*Inches*		*Inches*	
Dutch Harbor [1] [2]	29.06	−0.59	29.80	16th	28.30	25th
St. Paul [1]	29.29	−0.40	29.98	16th	28.72	26th
Kodiak [1]	29.27	−0.37	29.76	19th	28.66	[5] 5th
Midway Island [1]	29.96	−0.04	30.16	14th	29.78	[5] 11th
Honolulu [3]	30.02	+0.02	30.11	12th	29.85	18th
Juneau [3]	29.76	−0.12	30.22	9th	29.02	16th
Tatoosh Island [3] [4]	30.09	+0.15	30.69	6th	29.37	16th
San Francisco [3] [4]	30.16	+0.07	30.48	5th	29.47	31st
San Diego [3] [4]	30.09	+0.03	30.35	5th	29.72	31st

[1] P. m. observations only.
[2] 30 days.
[3] A. m. and p. m. observations.
[4] Corrected to 24-hour mean.
[5] And other dates.

In the American Tropics vessels experienced gales off Cape Corrientes on the 1st and 29th, and in the Gulf of Tehuantepec on the 1st, 9th, 10th, 23d, and 27th, those in the latter region being northers blowing down from the Cordilleras.

At Honolulu the winds were generally light, prevailing as usual from the east, and with a maximum velocity for the month of only 33 miles an hour, from the northeast, on the 21st.

Very little fog was reported except along the American coast between the thirtieth and fiftieth parallels, and over the southern part of the Gulf of Alaska. The only record of fog occurring in east longitudes comes from the China Sea, where it was observed on the 14th about midway between Hongkong and Manila.

The consequences of the low-pressure conditions upon the weather were increased cloudiness and precipitation, as well as increased warmth, considering the normal, over a great area. Juneau reported the warmest January in 31 years of record; North Head, Wash., next to the warmest in 38 years; and Honolulu the warmest in 37 years. A number of trans-Pacific steamers reported much rain, snow, or hail along the northern passages.

As might be expected gales were frequent over most of the ocean north of the thirtieth parallel, and on that parallel a near hurricane wind was experienced by a steamer on the 9th, near 152° east longitude. Storm to hurricane velocities experienced elsewhere, so far as reported, occurred on the 4th near 45° N., 170° E.; on the 25th near 35° N., 155° W.; and on the 26th and 29th near 35° N., 140° W. Perhaps the stormiest five-degree square of the ocean was that bounded by the thirty-fifth and fortieth parallels north, and the one hundred and fortieth and one hundred and forty-fifth meridians west, with gales on at least 25 per cent of the days. The days on which gales simultaneously covered the most widespread areas east and west of the one hundred and eightieth meridian were the 29th to the 31st.

Lows entered the American mainland on the 1st, 5th, 8th, 10th, 14th, 16th, 24th, 28th, and 31st, the last one by way of northern California and Oregon; the others at higher latitudes.

TROPICAL CYCLONES OF JANUARY, 1926

South Pacific Ocean.—A disastrous hurricane passed over Samoa on January 1, striking principally, it seems, the American island, where villages and crops were reported in many instances as completely destroyed, and roads in places as blocked by landslides and fallen trees. A food famine was reported imminent. So far as known no lives were lost. At Tutuila the barometer began to fall at an early hour. Light easterly breezes increased in velocity to a fresh gale, and finally, at 3 and 4 o'clock in the afternoon, to a full hurricane. At 4:05 p. m. the wind dropped to a calm and so remained for about 30 minutes, when it was followed by east to east-northeast winds of moderate to gale force until 8 p. m., after which there were gentle variable breezes. The lowest pressure was 28.75 inches.

Indian Ocean.—Between January 30 and February 2 a tropical cyclone hit the island of Madagascar. The village of Vapomandry was destroyed, and a tidal wave came into the port of Tamatave, on the east coast. So far as known there was only one fatality. No data are at hand regarding the severity of the storm at sea.—*W. E. Hurd.*

DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

The pressure distribution over the northeast Pacific was close to normal up to about the 24th with the continental extension of the North Pacific statistical anticyclone rather more intense than usual over the Great Basin region. During the last week of the month this anticyclone gave way both over the ocean and the continent and several much-needed rainstorms prevailed over central and northern California. On p. 2 of this REVIEW MR. T. R. Reed, of the San Francisco Weather Bureau Office, gives the mean pressure distribution over the Pacific leading up to the rains above mentioned.—*A. J. H.*

CYCLONES AND ANTICYCLONES

By W. P. DAY

While abnormally low air pressures were being recorded over the North Pacific in the vicinity of the Aleutian Islands and in northern and western Alaska during January, an apparently compensating excess of pressure occurred along the Pacific coast south of Alaska. High pressure was persistent over the Pacific States and the Plateau region, except near the middle of the month and again near the end. With this general distribution of pressure, nearly half of the LOWS plotted were of the Alberta type, 10 out of a total of 22. However, four LOWS which developed over the south and southwest were more important as storms, the Alberta type generally giving rather light precipitation.

The six HIGHS from the Canadian interior were of moderate proportions and most of them moved rapidly. Thirteen HIGHS were plotted, which is about normal.

FREE-AIR SUMMARY

By V. E. JAKL

It will be noted at once from the departures on Table 1 that free-air temperatures were lower than normal over the southern stations and higher than normal over the northern. This is in agreement with the distribution of departures for the surface over corresponding portions of the country as shown by Chart III, this Review. Ellendale and Drexel were above normal, Broken Arrow, Due West, and Groesbeck below normal, and Royal Center approximately normal. The departures were largest at Ellendale, where the excess over normal was especially evident in the lower levels, diminishing thence upward. Over Drexel the departures also diminished with altitude, while elsewhere there was a tendency for a perceptible increase in the deficiency in temperature with altitude, indicating a stronger average lapse rate at all stations than normal.

The resultant winds, as given in Table 2, apparently show no decided relation to the departures in temperature, that is, the southern stations do not show an excess—nor the northern stations a diminution—of northerly component as compared with the normal, such as might be expected from the temperature record. This is plainly evident in the wind record for Ellendale, where the resultants are almost identical with the normal. For example, in the record of the 28th–29th (see following table) it will be noted that the greatest change to warmer on the 29th from the relative low temperatures on the 28th occurred at those levels where the wind direction changed from southerly to one having a northerly component. This change was typical of a condition that repeated itself a number of times during the month at Ellendale, in which the southerly winds in the rear of a cold HIGH were replaced by westerly to northwesterly winds in the south and southwest portion of a relatively warm LOW approaching rapidly from the northwest or west-northwest. The pronounced character of this change at Ellendale was, moreover, emphasized by the fact that the minimum surface temperature on the 28th, −26.7°, was the lowest of the month, and the maximum surface temperature on the 29th, 10°, lacked only about a degree of being the highest of the month. It will be seen by the record of temperature at 750 meters on the 29th that it was necessary for insolation to warm the lowest layers only to the extent of heating the surface to the potential temperature that prevailed 300 meters higher up, in order to reach a maximum surface temperature even greater than that actually observed.

Altitude m. s. l.	Jan. 28		Jan. 29	
	Temperature	Wind direction	Temperature	Wind direction
Meters	°C.		°C.	
444 (surface)	−22.5	S.	−10.0	SSW.
500	−22.3	S.	−6.8	SW.
750	−21.8	SSW.	7.8	NW.
1,000	−19.7	SSW.	6.1	NW.
1,500	−12.7	SW.	2.6	WNW.
2,000	−11.2	WSW.	1.3	W.
2,500	−8.6	W.	−1.0	W.
3,000	−10.2	NW.		

Wind directions aloft were on the whole principally west, except that over the northern plains States they were northwest at all altitudes. Also over the northeastern portion of the country there was a well defined tendency for the winds to become northwesterly at altitudes of 3,000 meters and above. Velocities averaged higher than normal, a fact apparently associated with the rapid movement of HIGHS and LOWS that featured the month. Strong winds aloft were particularly in evidence from the 26th to 28th, when winds of 30 to 40 meters per second from west to northwest were recorded at various altitudes at Broken Arrow, Drexel, Due West, Ellendale, Groesbeck, Ithaca, Lansing, Royal Center, and Washington. The tendency to an unusually strong drift in a general west to east direction during the month was also evidenced by the rare occurrence of winds of even moderate depth having an easterly component. The only instance of easterly winds to any comparatively high altitude occurring over an extended area was observed on the 8th, when, in connection with a HIGH that overlay the lower Lake region and New England States, winds having a decided component from the east to depths ranging from 3,000 to 4,000 meters were observed at Ithaca, Lansing, and Royal Center.

The cold wave condition that overswept middle sections of the country on the 11th–12th, is of interest from the standpoint of its progressive effect on upper-air temperatures. This is well shown by the record given in the following table, all the stations affected having been able to get observations to 3,000 meters or more while under the influence of the HIGH concerned. By comparing the two stations most widely separated in latitude, Ellendale and Groesbeck, it will be noted that the HIGH moderated much faster in the lower than in the upper levels as it passed southward.

Altitude, m. s. l.	Ellendale (444 meters) Jan. 11		Drexel (396 meters) Jan. 11		Broken Arrow (233 meters) Jan. 12		Royal Center (225 meters) Jan. 12		Groesbeck (141 meters) Jan. 12	
	Temperature	Wind direction	Temperature	Wind direction	Temperature	Wind direction	Temperature	Wind direction	Temperature	Wind direction
Meters	° *C.*		° *C.*		° *C.*		° *C.*		° *C.*	
Surface	−20.7	NW	−14.0	NNW.	−6.0	SW	−19.0	W	−0.5	N.
500	−21.0	NW	−14.9	NNW.	−7.5	SW	−17.9	WNW	−1.0	NNE.
1,000	−19.3	N	−13.5	N	−4.5	W	−17.8	W	−0.2	NNE.
1,500	−12.4	NNE.	−11.3	N	−6.3	WNW	−17.9	SW	−1.3	NNW.
2,000	−14.3	NNE.	−11.7	NNW.	−8.1	WNW	−14.1	WNW	−3.0	NNW.
2,500	−17.0	NNE.	−14.2	NNW.	−7.7	WNW	−15.8	NW	−5.5	WNW.
3,000	−20.0	N	−16.7	NNW.	−10.2	WNW	−17.8	NW	−8.8	WNW.
3,500	−21.5	N			−12.6	WNW	−20.0	WNW	−12.6	WNW.

A typical winter free-air record accompanying precipitation is that shown by the observation at Royal Center on the 17th, during which rain began and continued until the next day. Most of the precipitation, however, fell after the surface wind changed to northeast, attending the approach of the LOW center from the southwest.

Altitude, m. s. l.	Temperature	Relative humidity	Wind	
			Direction	Velocity
Meters	° *C.*	%		*m. p. s.*
225 (surface)	4.1	81	SSW	1.3
464	6.8	68	WSW	12.4
559	6.3	79	W	10.5
752	6.5	100	W	8.5
1,366	4.4	93	WSW	12.6
1,888	0.1	100	WSW	16.1
2,293	−1.7	83	WSW	17.7
2,768	−6.3	100	WSW	17.4
3,333	−7.8	100	WSW	

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during January, 1926*

TEMPERATURE (°C.)

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Drexel, Nebr. (396 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)	
	Mean	Departure from 8-yr. mean	Mean	Departure from 11-yr. mean	Mean	Departure from 5-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 8-yr. mean	Mean	Departure from 8-yr. mean
Meters												
Surface	2.4	−1.1	−3.6	+2.4	4.6	−1.5	−7.7	+3.1	6.7	−1.0	−3.6	+0.4
250	2.4	−1.1			4.5	−1.5			6.4	−1.1	−3.6	+0.6
500	2.2	−0.9	−4.1	+2.0	4.1	−1.3	−7.7	+3.0	5.8	−1.3	−4.7	+0.4
750	1.8	−1.1	−3.6	+2.0	3.2	−1.7	−6.9	+3.1	5.5	−1.5	−4.6	+0.7
1,000	1.4	−1.4	−2.4	+2.2	2.1	−2.2	−5.8	+2.7	5.1	−2.0	−5.0	+0.3
1,250	1.0	−1.7	−2.1	+1.9	1.4	−2.3	−5.3	+2.3	4.1	−2.7	−5.3	+0.1
1,500	0.7	−1.7	−2.7	+1.4	0.8	−2.1	−5.4	+2.2	3.2	−3.0	−5.8	−0.1
2,000	−0.8	−1.8	−4.2	+1.2	−0.6	−1.7	−7.0	+2.1	1.6	−3.0	−7.2	−0.5
2,500	−3.2	−1.8	−6.8	+0.8	−2.9	−2.1	−9.5	+1.8	−0.2	−2.6	−9.9	−1.2
3,000	−5.6	−1.8	−9.8	+0.3	−5.5	−2.4	−12.4	+1.6	−2.6	−2.7	−11.9	−0.8
3,500	−8.3	−2.0	−13.1	−0.5	−8.1	−2.5	−15.1	+1.7	−6.3	−3.6	−14.4	−0.6
4,000	−11.1	−2.0	−16.7	−1.3	−11.7	−2.7	−18.5	+0.9	−9.9	−4.4	−15.5	−0.4
4,500	−13.2	−1.4	−18.8	−0.4			−22.4	−0.2	−11.2	−2.9		
5,000			−21.2	+0.3								

RELATIVE HUMIDITY %

Altitude m. s. l.	Broken Arrow Mean	Departure	Drexel Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure
Surface	71	0	79	−3	73	+4	80	−2	79	+1	73	−6
250	71	0			72	+4			77	+1	73	−6
500	66	+1	77	−2	64	+1	79	−1	73	+1	72	−2
750	61	+1	71	−1	62	+2	74	+1	69	+1	70	+1
1,000	58	+3	64	−2	59	+1	70	+4	65	+2	68	+4
1,250	54	+3	60	−2	54	−2	67	+6	63	+4	66	+7
1,500	50	+3	59	0	46	−7	64	+5	61	+6	59	+4
2,000	45	+3	54	−3	40	−8	60	+2	52	+3	51	+1
2,500	43	+2	52	−4	34	−9	61	+3	42	−4	50	−1
3,000	42	+1	53	−3	32	−9	62	+4	34	−8	52	0
3,500	41	0	50	−4	33	−8	64	+8	32	−8	56	0
4,000	41	−1	48	−5	59	+14	68	+13	32	−6	86	+30
4,500	28	−13	48	−5			72	+13	30	−7		
5,000			48	−6								

VAPOR PRESSURE (mb.)

Altitude m. s. l.	Broken Arrow Mean	Departure	Drexel Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure
Surface	5.45	−0.44	3.88	+0.51	6.44	−0.43	2.92	+0.48	8.18	−0.52	3.82	−0.06
250	5.42	−0.43			6.32	−0.46			7.88	−0.49	3.77	−0.02
500	4.95	−0.29	3.64	+0.42	5.51	−0.62	2.86	+0.46	7.28	−0.46	3.37	+0.05
750	4.48	−0.27	3.38	+0.43	5.03	−0.70	2.80	+0.54	6.68	−0.52	3.23	+0.19
1,000	4.02	−0.25	3.25	+0.45	4.45	−0.88	2.77	+0.56	6.15	−0.41	3.01	+0.21
1,250	3.49	−0.35	3.02	+0.37	3.76	−1.07	2.71	+0.57	5.53	−0.40	2.85	+0.29
1,500	3.04	−0.37	2.82	+0.33	2.84	−1.42	2.55	+0.53	4.94	−0.38	2.51	+0.19
2,000	2.51	−0.26	2.34	+0.17	2.49	−0.97	2.11	+0.36	3.58	−0.65	1.90	+0.01
2,500	2.04	−0.27	1.88	+0.07	1.62	−0.98	1.76	+0.33	2.27	−1.13	1.58	−0.05
3,000	1.69	−0.28	1.60	+0.09	1.25	−0.83	1.43	+0.32	1.30	−1.39	1.39	−0.03
3,500	1.37	−0.32	1.16	−0.05	1.14	−0.64	1.17	+0.38	0.84	−1.34	1.28	+0.01
4,000	1.14	−0.32	0.98	+0.02	1.85	+0.21	0.97	+0.41	0.76	−1.04	1.92	+0.87
4,500	0.55	−0.62	0.94	+0.15			0.76	+0.19	0.65	−0.90		
5,000			0.90	+0.23								

TABLE 2.—*Free-air resultant winds (m. p. s.) during January, 1926*

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)				Drexel, Nebr. (396 meters)				Due West, S. C. (217 meters)			
	Mean		8-year mean		Mean		11-year mean		Mean		5-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Meters												
Surface	S. 51°W.	2.6	S. 45°W.	1.2	S. 83°W.	1.9	W.	1.5	S. 83°W.	2.2	N. 79°W.	1.1
250	S. 50°W.	2.6	S. 37°W.	1.3					S. 84°W.	2.5	N. 81°W.	1.3
500	S. 45°W.	4.1	S. 32°W.	2.4	S. 87°W.	3.5	N. 85°W.	2.5	S. 78°W.	4.3	S. 88°W.	2.6
750	S. 58°W.	4.6	S. 41°W.	3.2	N. 69°W.	5.5	N. 78°W.	4.3	S. 78°W.	6.3	S. 82°W.	4.2
1,000	S. 81°W.	5.2	S. 37°W.	5.6	N. 66°W.	7.3	N. 77°W.	5.7	S. 86°W.	7.5	S. 81°W.	5.5
1,250	S. 77°W.	7.0	S. 70°W.	4.2	N. 60°W.	9.4	N. 75°W.	7.0	S. 87°W.	11.3	S. 89°W.	7.7
1,500	S. 85°W.	7.7	S. 70°W.	5.4	N. 61°W.	10.0	N. 73°W.	7.9	N. 88°W.	16.5	S. 87°W.	10.2
2,000	W.	9.2	S. 81°W.	7.4	N. 68°W.	11.7	N. 74°W.	10.5	S. 85°W.	18.1	S. 88°W.	12.9
2,500	N. 82°W.	10.5	S. 85°W.	8.7	N. 74°W.	13.7	N. 80°W.	12.7	S. 84°W.	21.5	S. 89°W.	15.9
3,000	N. 82°W.	11.7	N. 88°W.	10.0	N. 68°W.	16.3	N. 79°W.	14.2	S. 85°W.	19.7	S. 87°W.	16.8
3,500	N. 82°W.	12.2	N. 84°W.	10.5	N. 66°W.	18.2	N. 80°W.	15.5	N. 79°W.	21.8	S. 85°W.	16.8
4,000	N. 72°W.	12.7	N. 85°W.	11.3	N. 60°W.	16.3	N. 85°W.	17.0	S. 68°W.		S. 82°W.	16.1
4,500	N. 67°W.	15.7	N. 88°W.	11.0	N. 67°W.	17.1	N. 79°W.	17.6	S. 68°W.		N. 82°W.	15.4
5,000	N. 68°W.	12.7	N. 83°W.	10.8	W.	18.0	N. 80°W.	17.7				

Altitude m. s. l.	Ellendale, N. Dak (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)			
	Mean		9-year mean		Mean		8-year mean		Mean		8-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Meters												
Surface	N. 59°W.	3.9	N. 59°W.	2.9	N. 42°W.	1.6	N. 38°W.	0.6	S. 65°W.	2.8	S. 53°W.	2.0
250					N. 57°W.	1.7	N. 64°W.	0.6	S. 60°W.	3.3	S. 49°W.	2.5
500	N. 63°W.	4.6	N. 65°W.	3.3	N. 88°W.	2.5	S. 62°W.	1.5	S. 67°W.	7.6	S. 60°W.	5.1
750	N. 51°W.	7.1	N. 65°W.	5.3	S. 68°W.	2.9	S. 61°W.	2.5	S. 75°W.	8.5	S. 67°W.	6.6
1,000	N. 52°W.	8.5	N. 62°W.	6.5	S. 72°W.	3.6	S. 64°W.	3.4	S. 84°W.	8.5	S. 75°W.	7.6
1,250	N. 53°W.	9.2	N. 63°W.	7.5	S. 78°W.	4.3	S. 71°W.	4.6	S. 87°W.	7.0	S. 80°W.	8.6
1,500	N. 56°W.	9.1	N. 64°W.	8.0	S. 82°W.	4.9	S. 74°W.	5.8	S. 87°W.	10.4	S. 83°W.	10.0
2,000	N. 59°W.	11.8	N. 65°W.	10.6	S. 86°W.	5.7	S. 79°W.	7.3	N. 84°W.	11.7	S. 84°W.	11.8
2,500	N. 71°W.	13.1	N. 67°W.	12.8	S. 87°W.	8.3	S. 80°W.	8.8	N. 84°W.	12.6	S. 89°W.	13.4
3,000	N. 70°W.	15.8	N. 69°W.	14.2	S. 87°W.	11.8	S. 80°W.	10.3	N. 76°W.	11.5	S. 89°W.	13.6
3,500	N. 64°W.	15.8	N. 67°W.	15.4	S. 86°W.	11.5	S. 82°W.	11.4	N. 86°W.	9.9	S. 81°W.	12.7
4,000	N. 79°W.	15.3	N. 61°W.	16.7	S. 68°W.	11.1	S. 73°W.	12.3	S. 68°W.	23.2	S. 74°W.	16.6
4,500	N. 80°W.	18.3	N. 58°W.	18.6	S. 68°W.	15.1	S. 74°W.	14.2				
5,000												

TABLE 3.—*Mean free-air temperatures, relative humidities, vapor pressures, and resultant winds (m. p. s.) during January, 1926, at Washington, D. C.*

Altitude m. s. l.	Naval air station (7 meters)			Weather Bureau (34 meters)—	
Wind	Temperature	Relative humidity	Vapor pressure	Wind	
Meters	(° *C.*)	(*Per cent*)	(*mb.*)	*Direction*	*Velocity m. p. s.*
Surface	−3.1	77	3.79	N. 55° W.	1.6
250	−1.8	71	3.91	N. 72° W.	4.2
500	−1.6	65	3.77	N. 74° W.	6.6
750	−1.7	63	3.70	N. 72° W.	8.1
1,000	−2.2	62	3.49	N. 77° W.	8.5
1,250	−3.0	62	3.25		
1,500	−3.5	60	3.02	N. 70° W.	11.6
2,000	−4.7	58	2.70	N. 73° W.	12.5
2,500	−6.5	54	2.25	N. 69° W.	15.7
3,000	−7.9	57	2.10	N. 84° W.	18.5

THE WEATHER ELEMENTS

By P. C. DAY, In Charge of Division

PRESSURE AND WINDS

Probably the most notable fact concerning the weather of January, 1926, was the general absence of particularly unfavorable or unpleasant weather. As in the preceding month atmospheric pressure was high over the Plateau and Pacific coast sections and no storms moved inland from the North Pacific States until near the end of the month, and again as in December this high-pressure area was mainly a local phenomenon and lacked the cold conditions usually attending such high pressure when augmented through anticyclones moving into that region from the Canadian Northwest.

Over central and eastern districts cyclonic disturbances were comparatively infrequent and of rather mild character, though they brought generally heavy precipitation over some southeastern districts.

The first important cyclone developed over the far Southwest about the 1st and moved slowly toward the Great Lakes attended by scattered and generally light precipitation over the southern mountains and Great Plains, but becoming heavier toward the Mississippi Valley and portions of the Gulf States. This storm gave precipitation over a wide area, though it lacked any marked severity until reaching the St. Lawrence Valley where pressure became unusually low, and it passed eastward into the ocean as a severe storm.

A slight barometric depression that first appeared in the east Gulf on the 7th and had moved to the Georgia coast by the morning of the 8th was attended by heavy rains over the Southeastern States and by more or less precipitation as it moved northward near the coast during the following day or two.

Several unimportant low areas, mostly forming near the Great Lakes, gave light precipitation in that region from the 10th to 15th. About the latter date another disturbance formed in the Southwest and by the 17th it was central over Arkansas and heavy rain was falling over portions of the West Gulf States and lower Mississippi Valley. As this storm moved northeastward toward the lower Lakes heavy rains occurred over portions of the Ohio Valley and east Gulf States, continuing during the following day into the Northeastern States.

A rather unusual storm formed in the middle plateau about the 17th and moved slowly southeastward to the south Texas coast by the morning of the 21st, whence it moved with great rapidity and markedly increased severity to the Canadian Maritime Provinces during the following 24 hours, attended by heavy rains in the Ohio Valley and some other districts and by more or less snow in the lower Lake region and to the eastward and northeastward.

During the remainder of the last decade no important storms visited the eastern two-thirds of the country though some heavy rains occurred near the end over the Southeastern States, particularly in southern Florida where locally some of the heaviest rains ever known in January occurred.

The last few days of the month were notable for the breaking up of the pressure distribution that had prevailed for a long period over the far West and Northwest. The high pressure area over the plateau and Pacific Coast States began to disintegrate and by the 29th a low pressure area appeared off the North Pacific coast and rain had set in from central California northward, and during the following few days more or less rain or snow occurred over much of the plateau and Pacific coast area, some heavy rains occurring at the lower elevations of California and considerable snow falling in the mountains, relieving a severe drought and improving the outlook for a substantial water supply.

No important anticyclones moved into the United States from the Canadian Northwest during the first two decades, though one of moderate intensity at the beginning of the last decade brought sharp changes of temperature from the Great Plains region eastward, the weather continuing cold in the Southern States for several days, particularly in Texas, where on the 24th and 25th freezing occurred to the extreme southern part of the State. During the remainder of the decade several anticyclones of only moderate intensity moved eastward along the northern border from the Dakotas to New England, causing sharp temperature changes over the northern districts, and about the 29th the coldest weather of the month occurred over some Middle Atlantic and Northeastern States.

From the Rocky Mountains westward the average pressure was above normal, the maximum occurring over the northern plateau. The eastern two-thirds of the United States and the greater part of Canada had pressure averages less than normal, the greatest deficiencies occurring along the northern border from the Dakotas to New England.

The winds were mainly from northerly points in the Gulf States and southern plains and from the south or southwest over the Atlantic Coast States, the Ohio and middle Mississippi Valleys, the central plains, and Lake region. Elsewhere they were variable.

In the main there were few severe storms save along the North Atlantic coast. Over the North Pacific coast, where January is usually a stormy month, high winds were noted in only a few instances. A table showing the important facts concerning the more severe storms of the month appears at the end of this section.

TEMPERATURE

The month was remarkably free from severe cold and no low-temperature records were broken, though it was quite cold in southern Florida on the 12th and again on the 15th. On the latter date temperatures as low as 24° were reported from points in the trucking districts of the Everglades, where practically all tender vegetation was destroyed. Again from the 20th to 25th the temperatures were low over the west Gulf States, freezing weather

extending to the coast districts of Texas on the 24th and 25th.

Over all northern districts of the United States from the Atlantic to the Pacific, the average temperatures for the month were above the normal, the excesses increasing toward Canada, where, in portions of the Northwest Provinces, the monthly means were 20° or more above normal, and among the highest of record for January. Farther north, at Eagle, Alaska, near the Arctic Circle, the average temperature was nearly 30° above normal and it was apparently much warmer than usual over all portions of that Territory. The month was colder than normal over most southern districts, particularly in Texas and New Mexico, where moderate cold persisted for long periods.

Some sharp contrasts were noted in temperature conditions over near-by areas, notably at Yellowstone Park and Lander, Wyo.; the former was materially above normal and the latter nearly 4° below, while farther south at Grand Junction, Colo., it was again more than 4° above. Similarly, in the Great Valley of California there were local areas with averages materially less than normal while surrounding areas showed values well above.

The warmest periods of the month were mainly during the latter half and over much of the territory from the Mississippi Valley eastward about the 18th to 20th, though in a few localities the warmest weather occurred during the first week. West of the Mississippi the warmest days were mainly toward the end of the month.

The coldest periods also occurred mostly during the latter half, and frequently during the last decade, notably over the Great Plains and Gulf States from the 20th to 24th, and over most northern districts from the Dakotas eastward on the 28th or 29th.

PRECIPITATION

Considering the entire country about one-half had precipitation above normal while over the other half it was deficient. The excesses were confined mainly to the Southern States from Texas eastward and to the Great Plains area. Over the Gulf States the amounts ranged from 2 to 5 inches above normal, but in the Great Plains they were usually less than 1 inch above. Over the middle and upper Mississippi Valley and thence eastward to the Atlantic, save in portions of the Appalachian Mountains, precipitation was nearly everywhere less than usually falls in January, and similar conditions existed in the States west of the Rocky Mountains, save locally at a few points in California and elsewhere. Over the coast districts from northern California to Washington the precipitation was mainly from 2 to 4 inches deficient.

Precipitation was rather irregularly distributed for a winter month and ranged from none at numerous points in the Southwest to nearly 15 inches at points in the Southeastern States.

In portions of the lower Lakes there was precipitation on nearly every day, while in the far west, notably in California, there was little until near the end. In the Gulf States there were local heavy falls, particularly in the vicinity of Miami, Fla., where unusually heavy rains occurred on the night of the 29th–30th, flooding low ground and causing heavy losses in the near-by farming districts.

SNOWFALL

Snow was widely but irregularly distributed and measurable amounts were recorded at points far south of its usual occurrence. Greater depths were reported from points in southern Texas, where snow rarely falls, than occurred at numerous points in the Great Lakes region, where the fall is usually heavy.

Generally speaking, there was less snow than usually falls in January, though in limited areas there was more, notably portions of West Virginia and Ohio, where the fall was unusually heavy, and there were some heavy falls in eastern Colorado, northeastern Wyoming and portions of Nebraska and South Dakota.

In southern Texas there were unusually heavy falls about the 23d and 24th, the amounts at numerous points being the greatest ever known.

In the western mountain districts there was mainly less snow than usually falls in January. This was most notable in the high mountains of California and near-by States, where but little snow had accumulated until near the end of the month.

At the close of the month the northern third of the country east of the Rocky Mountains had a more or less general snow cover, though the depths were mainly small except from Pennsylvania to New England, over the upper Lake region and thence westward, except in portions of Montana where there was little or no cover.

In the western mountains the stored snowfall at the higher elevations was far less than normal over the central and southern districts, but to the northward the amounts approached more nearly those common to the end of January.

Despite the moderate warmth of the month conditions were mainly favorable for ice formation of sufficient thickness for harvest and a good supply was gathered over most sections where provision is usually made for its storage.

RELATIVE HUMIDITY

In the main relative humidity was higher than is usually experienced in a midwinter month, though the excesses were not large except locally over the Great Plains and along the east slopes of the Rocky Mountains. It was quite low at a few points in the far Southwest, and generally less than normal over the Appalachian Mountain region.

SEVERE LOCAL HAIL AND WIND STORMS, JANUARY, 1926

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Kraemer, La.	4	7.40 a. m.	150	3	$3,000	Small tornado	One home demolished and others slightly damaged; five persons injured. Path 170 yards long.	Official, U. S. Weather Bureau. Times-Picayune (New Orleans, La.).
Marquette, Mich.	6					Wind and snow	Several persons injured on slippery sidewalks. No damage to property reported.	Official, U. S. Weather Bureau.
New York City, N. Y.	9			4		do	The deaths reported occurred in automobile accidents due to storm. Several persons injured.	New York Telegram (N. Y.).
Sandy Hook, N. J., and vicinity.	9			4		Gale	Four barges wrecked on rocks at Highland Beach, others driven shore.	Official, U. S. Weather Bureau.
Taylor, Tex. (vicinity of)	16	P. m.				Probably a tornado.	A number of farm buildings demolished and others damaged; some livestock killed.	Taylor Daily Press (Tex.).
Abilene, Tex. and vicinity	20-22					Glaze	Considerable damage to poles and wires	Official, U. S. Weather Bureau.
Ludington, Mich.	23					High winds	Vessels on Lake Michigan suffer perilous experiences.	Do.
Ohio	27-28					Wind and snow	Some damage to buildings in northern portions; traffic generally disorganized; much suffering from cold.	Press (Binghamton, N. Y.).
Alpena, Mich.	28					do	A few telephone lines reported down and some trees uprooted.	Do.
Beachmont, Mass., and vicinity.	28					Strong wind	Fifty-five electric light poles blown down; traffic blocked.	Do.
New York State	28					Wind and snow	Traffic delayed; much distress from cold	Sun (Norwich, N. Y.); Press (Binghamton, N. Y.).
Port Huron, Mich.	29					do	Train service suspended. No property damage reported.	Official, U. S. Weather Bureau.
San Francisco, Calif.	29					Wind	Roofs of three buildings damaged by falling of six-story scaffold. Several persons narrowly escape injuries.	Chronicle (San Francisco, Calif.).
Miami, Fla., and vicinity	29-30					Thunderstorm	Telephone and light service interrupted; lowlands flooded causing 50 per cent or more loss of tomato crop in farm districts north and south of city.	Official, U. S. Weather Bureau.

STORMS AND WEATHER WARNINGS

WASHINGTON FORECAST DISTRICT

On the afternoon of the 7th, advices were disseminated for strong east and southeast winds between Pensacola and Tampa in connection with a disturbance developing over the northeast Gulf of Mexico. On the evening of that day storm warnings were ordered from Savannah, Ga., to Delaware Breakwater, Del. On the following afternoon the warnings were extended northward from Delaware Breakwater to Boston, Mass.; and on the morning of the 9th again extended northward to Eastport, Me. Strong winds and gales occurred substantially as indicated in the advices.

Storm warnings were ordered at noon of the 14th from Fishers Island, Long Island, to Eastport, Me., in connection with a disturbance of increasing intensity passing north-northeastward from near Cape Hatteras. The disturbance moved rapidly northeast with greatly increased intensity, and while strong winds and gales occurred immediately offshore, coast stations did not report high velocities. Warnings were lowered in the evening south of Portland, Me., and to the north early on the morning of the 15th.

Storm warnings were ordered on the morning of the 18th from Delaware Breakwater to Boston, and on the afternoon of that day were extended northward to Eastport. Strong winds and gales occurred over the region indicated in the advices.

On the afternoon of the 21st, southwest storm warnings were ordered displayed from Southport, N. C., to Sandy Hook, N. J. They were changed to northwest the following morning, at the same time that northwest warnings were displayed from Sandy Hook to Eastport. Strong winds occurred generally over the region of display and gales north of Hatteras.

Southwest warnings were ordered on the evening of the 23d from Delaware Breakwater to Eastport and were changed to northwest at noon of the 24th. Strong winds and gales occurred substantially as indicated.

On the afternoon of the 25th, northeast storm warnings were disseminated from Wilmington, N. C., to Delaware Breakwater, in connection with a disturbance of slight but increasing intensity over northeast Florida; but they were ordered down the same evening owing to the fact that the disturbance moved off the coast and it was not until the morning of the 27th that it approached the Nova Scotia coast attended by gales.

Northwest storm warnings were displayed at 9.30 a. m. of the 28th from Norfolk, Va., to Eastport and strong west and northwest winds and gales occurred.

On the morning of the 31st northeast storm warnings were ordered from Delaware Breakwater to Boston in connection with a disturbance of increasing intensity over South Carolina. Warnings were extended that evening from Boston to Eastport, and changed to northwest on the following day from Sandy Hook northward. Severe winds and gales occurred as indicated in the advices.—*R. H. Weightman.*

CHICAGO FORECAST DISTRICT

On January 1, 1926, the forecast work for the States of Montana and Wyoming was transferred to the Denver forecast district, and the States now included in the Chicago district are 11 in all, namely, upper and lower Michigan, Indiana, Illinois, Wisconsin, Missouri, Iowa, Minnesota, North Dakota, South Dakota, Nebraska, and Kansas; also the Great Lakes.

The month of January was exceptionally mild over most of the Chicago forecast district, especially in the Great Plains States. The average daily excess in temperature over the normal in North Dakota, for instance, exceeded 13°. However, in the extreme eastern portion of the district the excess was slight. Precipitation throughout the district varied considerably, but it was near the normal over the greater portion.

The month was uneventful from a weather standpoint until about the 10th, when a rather deep barometric depression passed eastward over the Great Lakes, with its center well to the north, followed by a cold HIGH area of moderate proportions which first made its appearance in northern Manitoba. An advisory message for strong winds was sent out to open ports on Lake Michigan on the morning of the 10th, and this was repeated in the evening, as the winds promised to be rather strong, and this later proved to be true. Moreover, cold wave warnings were issued in the evening of the same date and on the morning of the 11th from Minnesota and Iowa eastward and southward over Illinois and Indiana. The cold wave moved in with great rapidity and considerable force over North Dakota before warnings could be issued, but this was due to the fact that observations from Le Pas were missing and not available at the time the forecast was made.

From the 13th to the 16th, a series of barometric disturbances passed across the Great Lakes and advisory messages for fresh and strong winds were sent to the open ports on the Lake.

Then disturbances began to develop in the Southwest and move northeastward across the southern portion of the district, mainly from the 17th to the 21st, and cold HIGH areas followed rapidly southeastward and southward in the rear of the depressions. Advisory messages for strong winds were issued for Lake Michigan, and cold wave warnings for the eastern and southern portions of the forecast district.

The next disturbance of importance developed in the Canadian Northwest on the night of the 22d, and pushed southeastward across the Great Lakes and was followed by another cold HIGH. Warnings of strong winds and cold waves were issued to the various interests affected throughout the district.

Additional storms followed across the Great Lakes in rapid succession from the Northwest during the period between the 25th and 29th, and the development and movement of the one on the 27th were so rapid that warnings issued to lake interests were rather late, although no casualties were reported.—*H. J. Cox.*

NEW ORLEANS FORECAST DISTRICT

Severe weather conditions overspread the district from the 20th to 25th, with a general cold wave and freezing to the west Gulf coast from the 24th to 25th, for which cold wave warnings were issued as follows: On the 19th at noon for Oklahoma and northwest Arkansas; 20th, a. m., for the northwestern portion of east Texas, extended at 8 p. m. over east Texas; the southeast portion of west Texas, and northern Louisiana, with warnings of freezing to the west Gulf coast by the morning of the 22d; 21st, a. m., repeated the eastern and southern portions of east Texas and extended over Louisiana and southeastern Arkansas. Livestock warnings were distributed in connection with this cold wave.

No cold waves occurred without warning. Frost or freezing warnings were issued for the southern portion of the district on the 9th, 10th, 11th, 12th, 13th, 26th, and 27th.

Storm warnings for the Texas coast and small craft warnings for the Louisiana coast were issued on the morning of the 21st. These warnings were justified. No general storm occurred without warning. "Norther" warning was issued for Tampico, Mexico, January 21, and the condition occurred as forecast.—*I. M. Cline.*

DENVER FORECAST DISTRICT

High pressures prevailed on the northern Rocky Mountain Plateau during most of the month, with the crests of the HIGHS generally farther north than in the average January. A succession of disturbances of marked intensity moved along the northern border, and frequent LOWS advanced eastward from the extreme Southwest. Although the month as a whole was stormy in the northern and eastern portions of the district, there was a remarkable absence of widespread cold waves.

On the evening of the 17th a cold wave warning was issued for eastern Montana, with temperatures of zero, or below, forecast by the following night. The warning was repeated on the morning of the 18th and extended to include northeastern Wyoming. On the morning of the 19th warning of a moderate cold wave was issued for eastern Colorado. These special warnings were verified.

Local cold waves, of which no warning was issued, occurred at Pueblo and Lander on the 12th, at Roswell on the 22d and at Flagstaff on the 26th.

Frost warnings which were generally verified were issued for southern Arizona as follows: South-central and southeastern Arizona, 4th and 5th; southern Arizona, with freezing temperature in southeast portion, 6th; southwestern Arizona, 14th to 22d, 24th to 28th, and 30th.—*J. M. Sherier.*

SAN FRANCISCO FORECAST DISTRICT

January opened with high barometric pressure over the continent west of the Rocky Mountains and over that area of the northeast Pacific Ocean lying between the California coast and the Hawaiian Islands and subnormally low pressure over the ocean to the north and northwestward with the center of minimum pressure over and south of the Aleutian Islands. This pressure distribution continued, with at times minor variations, until the latter part of the month when the HIGH off the California coast disappeared and the low pressure system previously central over and south of the Aleutian Islands enlarged and dominated the winds and weather over the entire northeast Pacific Ocean; that is, southward to below north latitude 30 degrees and westward beyond the meridian of 180 degrees. It is probable that the records of the past will not show barometric pressure as low and as persistently low as prevailed over the northeast Pacific Ocean throughout this month.

In the preceding paragraph it is noted that during the last 10 days of the month the high pressure area off the California coast disappeared. The disappearance or breaking down was attended by a remarkable reversal from the type of wind and weather that had prevailed in California during the preceding several weeks. The changed type was so extraordinary that the district forecaster felt confident that in the immediate future general rains would fall in the Pacific States, including California. Based on his knowledge of the succession of weather changes following a type reversal of this kind, a special forecast was issued on Tuesday, the 26th, to the effect that general rains would fall in the Pacific States the latter part of the then current week. Owing to the drouth then prevailing throughout California, this forecast was given an unusually wide dissemination by the press and by radiophone. The morning of Thursday, the 28th, rain set in along the coast from the San Francisco Bay region northward, and subsequently spread

to all parts of the Pacific States, terminating the drouth and a serious water shortage in many parts of California.

On a number of occasions storm warnings were issued for the Washington and Oregon coast and for the north California coast. No storms occurred without adequate and timely warnings. Frosts were frequent in California and called for the issue of frost and freezing temperature warnings. The month was notable for the prolonged period of low temperature and fog over the valleys of northern California. At such times the temperatures on the valley floors would be near or below freezing, while at higher altitudes, as for example at Mount Hamilton, the temperatures were notably higher, at times as much as 10° to 15°. A special forecast of the coming of rains near the end of the month was issued for the citrus regions. Rain forecasts are greatly appreciated by the growers, as adequate warnings permit prompt picking of fruit for immediate future demands. Picking is carried on with difficulty when the ground is thoroughly wetted.—*E. H. Bowie*.

RIVERS AND FLOODS

By H. C. FRANKENFIELD

Heavy rains between January 4 and 7 over Mississippi and Alabama necessitated warnings of moderate floods for the Pearl River system of Louisiana and Mississippi and the Tombigbee, Black Warrior and lower Alabama Rivers of Alabama. The floods occurred as forecast, and the resulting damage was very small.

A pronounced storm of southwestern type was attended by heavy rains on January 16–17 in the lower Ohio Valley and the Gulf States, continuing January 17–18, and extending through the South and Middle Atlantic States. On January 18–19, the rains covered New England, but in more moderate quantity. Although the temperatures were high and some snow was melted, there were no floods reported in New England and the Middle Atlantic States. To the southward and southwestward, however, floods were general, yet not of serious character. They occurred as a rule between January 18 and 22 (January 17 in the lower Altamaha River). The Santee flood was prolonged as usual and the river was still above the flood stage at the close of the month. The usual warnings were issued for all the floods, and they were well verified, except over certain sections of South Carolina and Alabama, where the impounding of water in one instance, and the release of impounded water in another, prevented the rivers below from reaching their indicated crests. The reported losses due to these southern floods was only $14,070, almost entirely through enforced suspension of certain business activities for a few days, while the value of property saved through the warnings was given as $38,025.

General rains from the Ohio Valley eastward and southward between January 17 and 22 were followed by a decided rise in all the rivers of the Ohio Basin, but flood stages were not reached except in the Ohio River between Evansville, Ind., and Shawneetown, Ill., the Green River of Kentucky, and in a few smaller tributaries. The usual warnings were issued and the reported loss and damage was only $5,300, while property worth $50,000 was saved through the warnings.

An ice gorge that had formed early in January at Wolf Creek, Ky., broke and moved a little during the night of the 18th and 19th. It moved for the second time about noon of January 20, but soon reformed and held until some time during January 22. The heavy ice from this gorge passed Evansville during the afternoon of January 23, and by January 26 the ice had reached the mouth of the river.

A more serious condition of affairs prevailed in the upper Allegheny River of Pennsylvania. Much ice had formed during the cold days of the last week of December, 1925, but rains and high temperatures soon caused it to break, and by the night of January 7 ice was running from headwaters to Pittsburgh. On January 8 a gorge formed at a small island about 15 miles below Franklin, and one and one-half miles below Brandon, Pa. The river at Franklin rose from 4 feet on January 8 to 9 feet on January 10, when more cold weather froze the upper river. On January 18, the "southwestern" storm loosened the upper river ice and it piled above the original gorge, raising the river until at 5 a. m., January 20, the stage at Franklin was 20.3 feet, 5. 3 feet above the flood stage. At 6 a. m. of the same date the ice began to move, but piled up still higher at Brandon, the gorge extending 6 miles above Brandon. The river at Franklin fell slowly and on January 24 the stage was 13.8 feet, the water running under the ice. At the end of the month the situation was serious with the stage at Franklin 10.1 feet and the river above the gorge covered with 6 or 8 inches of solid ice. Thus far, however, while the gorge has caused considerable inconvenience, the losses will probably not exceed $18,000.

Local floods occurring about the same time in portions of the Wabash River drainage in Indiana, the smaller rivers of Arkansas, and in the Sulphur River of Texas were well forecast, and no damage of consequence was reported.

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
Atlantic drainage	Feet			Feet	
Schuylkill, Reading, Pa	10	19	19	11.0	19
James, Columbia, Va	18	20	20	18.9	20
Roanoke:					
Randolph, Va	21	20	20	21.9	20
Weldon, N. C	30	19	22	37.3	21
Cape Fear, Elizabethtown, N. C	22	21	21	22.0	21
Santee:					
Rimini, S. C	12	21	(1)	14.3	25
Ferguson, S. C	12	23	(1)	13.4	26
Broad, Blairs, S. C	15	19	20	17.6	19
Saluda:					
Pelzer, S. C	7	18	20	10.2	19
Chappells, S. C	14	20	22	15.5	20
Broad, Carlton, Ga	11	18	19	13.0	18
Altamaha, Everett City, Ga	10	17	21	10.1	20
East Gulf drainage					
Alabama, Selma, Ala	35	7	10	36.8	9
		21	24	35.9	22-23
Tombigbee, Lock No. 4, Demopolis, Ala	39	7	9	39.4	8-9
		20	30	48.2	26
Black Warrior, Lock No. 10, Tuscaloosa, Ala	46	18	20	49.4	19
Pearl:					
Jackson, Miss	20	10	11	20.2	11
		18	(1)	26.2	19
Columbia, Miss	18	6	6	18.0	6
West Pearl, Pearl River, La	13	7	16	16.0	9
		21	(1)	15.1	23
Great Lakes drainage					
St. Joseph, Montpelier, Ohio	10	20	20	10.3	20
Mississippi drainage					
Allegheny, Franklin, Pa	15	20	23	[2] 20.3	20
Ohio:					
Evansville, Ind	35	25	30	38.5	28-29
Dam No. 48, Cypress, Ind	35	26	30	37.0	29
Mount Vernon, Ind	35	27	31	36.8	29
Shawneetown, Ill	35	27	31	36.5	29
Little Kanawha, Glenville, W. Va	23	22	22	23.3	22

[1] Continued at end of month. [2] Ice gorge.

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
Mississippi drainage					
Green:	*Feet*			*Feet*	
Lock No. 6, Brownsville, Ky	30	23	26	33.6	24
Lock No. 4, Woodbury, Ky	33	22	28	41.6	25
Lock No. 2, Rumsey, Ky	34	25	(1)	38.3	29
Barren, Bowling Green, Ky	20	22	25	26.8	24
Wabash, Lafayette, Ind	11	19	21	13.0	20
Tippecanoe, Rochester, Ind	6	19	19	6.0	19
White, West Fork, Edwardsport, Ind	15	21	23	15.9	22
Big Pigeon, Newport, Tenn	6	18	19	8.4	18
Grand, Chillicothe, Mo	18	5	6	[3] 20.1	6
Petit Jean, Danville, Ark	20	22	25	22.6	24
Black:					
Corning, Ark	11	22	(1)	12.3	25
Black Rock, Ark	14	22	23	15.0	22
Cache, Patterson, Ark	9	29	(1)	9.8	31
Sulphur:					
Ringo Crossing, Tex	20	22	24	22.7	23
Finley, Tex	24	25	30	24.5	27
Ouachita:					
Arkadelphia, Ark	18	22	23	19.7	22
Camden, Ark	30	24	30	35.1	27

[1] Continued at end of month. [3] Estimated.

MEAN LAKE LEVELS DURING JANUARY, 1926

By UNITED STATES LAKE SURVEY

[Detroit, Mich., February 8, 1926]

The following data are reported in the "Notice to Mariners" of the above date:

Data	Lakes [1]			
	Superior	Michigan and Huron	Erie	Ontario
Mean level during January, 1926:	*Feet*	*Feet*	*Feet*	*Feet*
Above mean sea level at New York	600.46	577.37	570.02	244.28
Above or below—				
Mean stage of December, 1925	−0.39	−0.17	−0.37	−0.27
Mean stage of January, 1925	−0.60	−0.85	−0.60	+0.06
Average stage for January last 10 years	−1.50	−2.26	−1.49	−0.87
Highest recorded January stage	−2.32	−5.30	−3.53	−3.32
Lowest recorded January stage	−0.42	−0.85	−0.60	+0.48
Average departure (since 1860) of January level from December level	−0.25	−0.04	−0.02	+0.03

[1] Lake St. Clair's level: In January, 1926, 571.84 feet.

INFLUENCE OF WEATHER ON CROPS AND FARM OPERATIONS JANUARY, 1926

By J. B. KINCER

General summary.—Because of the frequent rainfall which kept the soil too wet to work during much of the month in the Southern States, farm activities made rather slow progress during January in that section of the country. At the close of the month the preparation for spring planting was about two weeks behind an average season in south Atlantic districts. Stream flow was increased materially, however, and some bottom lands in the extreme Southeast were flooded. There was also some damage by freezing weather which extended, about the middle of the month, into northern Florida, with some damaging frosts as far south as the southern division.

In the west Gulf area conditions were generally more favorable for farming operations, while stock interests were mostly favored throughout the Great Plains and in the grazing districts to the westward, except that much range was snow covered during most of the month in Wyoming and some adjoining sections which necessitated heavy feeding. Near the close of the month very beneficial rains occurred in Pacific coast sections, and the long drought that had prevailed in California was effectually relieved in most parts of the State.

Small grains.—In the Winter Wheat Belt the weather was mostly favorable, although a snow cover during much of the time was very light or entirely lacking. Temperatures were mostly mild, however, without materially harmful thawing and freezing conditions, and wheat made generally satisfactory progress, except the late-sown wheat in the eastern half of the belt. It did well in the far Northwestern States, and cereals made generally satisfactory advance in the South.

Ranges, pastures, and livestock.—Snowfall over the winter range districts in parts of the Rocky Mountain area necessitated heavy feeding, and there was considerable shrinkage of livestock, but otherwise the weather was generally favorable, and both the range and livestock continued in good condition for the season. It was especially favorable over the northern Great Plains where the mild weather and open range permitted stock to graze freely during much of the month, with a consequent saving of feed.

Miscellaneous crops.—There was considerable interruption to the preparation of soil for spring planting in the Southeastern States where some sections had twice the normal rainfall for the month. At the close, cabbage was reported about two weeks behind an average season in southern Alabama, while the planting of truck was backward in central Gulf districts. In general, however, winter truck crops made good progress in the west Gulf section, and were much benefited in California by rains during the latter part of the month. Some orchard heating was necessary in California, but there was little or no damage to citrus in that State.

CLIMATOLOGICAL TABLES

DESCRIPTION OF TABLES AND CHARTS

Table 1 gives the data ordinarily needed for climatological studies for about 176 Weather Bureau stations making simultaneous observations at 8 a. m. and 8 p. m. daily, 75th meridian time, and for about thirty-six others making only one observation. In addition, data appear for Juneau, Alaska, and Honolulu, Hawaii, where the observations are made at 8 a. m. and 8 p. m. of the time in local use. The altitudes of the instruments above ground are also given.

Table 2 gives, for about 35 stations of the Canadian Meteorological Service, the means of pressure and temperature, total precipitation, and depth of snowfall, and the respective departures from normal values except in the case of snowfall. The sea level pressures have been computed according to the method described by Prof. F. H. Bigelow in the REVIEW of January, 1902, pages 13-16.

Chart I.—*Tracks of centers* of ANTICYCLONES; and

Chart II.—*Tracks of centers* of CYCLONES. The Roman numerals show the chronological order of the centers. The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the observations at 8 a. m. and 8 p. m., 75th meridian time. Within each circle is also given (Chart I) the last three figures of the highest barometric reading, or (Chart II) the lowest reading reported at or near the center at that time, and in both cases as reduced to sea level and standard gravity. The inset map in Chart I shows the departure of monthly mean pressure from normal and the inset in Chart II shows the change in mean pressure from the preceding month.

Chart III.—*Temperature departures.* This chart presents the departures of the monthly mean surface temperatures from the monthly normals. The shaded portions of the chart indicate areas of positive departures and unshaded portions indicate areas of negative departures. Generalized lines connect places having approximately equal departures of like sign. This chart of monthly surface temperature departures in the United States was first published in the MONTHLY WEATHER REVIEW for July, 1909.

Chart IV.—*Total precipitation.* The scales of shading with appropriate lines show the distribution of the monthly precipitation, based on the reports from regular and selected cooperative observers. The inset on this chart shows the departure of the monthly totals from the corresponding normals.

Chart V.—*Percentage of clear sky between sunrise and sunset.* The average cloudiness at each regular Weather Bureau station is determined by numerous personal observations between sunrise and sunset. The difference between the observed cloudiness and 100 is assumed to represent the percentage of clear sky, and the values thus obtained are the basis of this chart. The chart does not relate to the nighttime.

Chart VI.—*Isobars at sea level, average surface temperatures, and prevailing wind directions.* The pressures have been reduced to sea level and standard gravity by the method described by Prof. Frank H. Bigelow on pages 13-16 of the REVIEW for January, 1902. The pressures have also been reduced to the mean of the 24 hours by the application of a suitable correction to the mean of 8 a. m. and 8 p. m. readings at stations taking two observations daily, and to the 8 a. m. or the 8 p. m. observations, respectively, at stations taking but a single observation. The diurnal corrections so applied will be found in the Annual Report of the Chief of the Weather Bureau, 1900-1901, volume 2, Table 27, pages 140-164.

The sea level temperatures are now omitted and average surface temperatures substituted. The isotherms can not be drawn in such detail as might be desired, for data from only the regular Weather Bureau stations are used.

The prevailing wind directions are determined from hourly observations at the great majority of the stations. A few stations determine the prevailing direction from the daily or twice-daily observations only.

Chart VII.—*Total snowfall.* This is based on the reports from regular and cooperative observers and shows the depth in inches of the snowfall during the month. In general, the depth is shown by lines inclosing areas of equal snowfall, but in special cases figures are also given. This chart is published only when the snowfall is sufficiently extensive to justify its preparation. The inset to this chart shows the depth of snow on the ground at the end of the month.

Charts VIII, IX, etc.—*North Atlantic weather maps of particular days.*

CLIMATOLOGICAL TABLES[1]

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, January, 1926

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	45.3	−0.6	Silverhill	77	21	3 stations	13	23	8.23	+3.17	Prattville	13.85	Tuscumbia	3.25
Arizona	40.1	−2.2	Yuma Date Orchard	79	31	Bright Angel Ranger Station.	−23	21	0.66	−0.66	Helvetia	2.09	8 stations	0.00
Arkansas	40.5	−0.6	Booneville	77	20	Harrison	−17	23	4.69	+0.59	Corning	9.18	Mountain Home	1.87
California	45.0	−0.3	Imperial	85	15	Helm Creek	−12	20	3.39	−2.05	Upper Mattole	11.91	2 stations	T.
Colorado	22.2	−1.0	Holly	72	30	Dillon	−35	23	0.66	−0.32	La Veta Pass	4.46	Holly	T.
Florida	57.6	−1.9	Davie	90	22	Garniers	21	14	5.80	+3.01	Vernon	13.42	Lake Wales	2.27
Georgia	45.6	−1.0	Saint George	84	5	Blue Ridge	6	23	7.66	+3.42	Lumber City	12.34	Brunswick	4.89
Idaho	23.8	+0.6	Chattin's Flat	54	30	Stanley	−14	27	1.26	−0.85	Avery	3.65	Glenns Ferry	0.22
Illinois	29.2	+2.4	2 stations	64	[2]19	Waukegan	−13	[2]12	1.68	−0.60	Golconda	3.95	Morrison	0.72
Indiana	28.6	0.0	Vevay	65	20	Marengo	−24	23	2.26	−0.79	Shelbyville	3.83	Frankfort	0.61
Iowa	22.7	+4.2	2 stations	58	30	Postville	−22	28	1.09	+0.01	Sanborn	2.68	Hampton	0.31
Kansas	32.7	+3.2	3 stations	68	[2]27	Burr Oak	−12	22	0.80	+0.14	Parsons	2.62	4 stations	T.
Kentucky	34.4	−1.1	Williamsburg	69	20	Farmers	−11	14	4.01	−0.37	Mount Sterling	5.65	Cold Springs	2.24
Louisiana	49.3	−1.9	Morgan City	78	20	Tallulah	20	14	6.63	+2.08	Reserve	10.17	Ruston	2.46
Maryland-Delaware	32.4	−0.2	Western Port, Md	72	5	Grantsville, Md	−11	29	3.10	−0.27	Grantsville, Md	4.50	Solomons, Md	2.26
Michigan	22.0	+2.1	South Haven	56	18	Humboldt	−32	25	1.48	−0.47	Sandusky	3.27	Iron Mountain	0.39
Minnesota	13.5	+5.4	Leech Lake Dam	50	2	Itasca State Park	−40	28	0.77	+0.06	Grand Marais	2.10	Alexandria	0.08
Mississippi	45.3	−1.4	4 stations	76	21	University	12	24	6.46	+1.25	Columbia	12.86	University	2.30
Missouri	32.7	+2.3	Koshkonong	70	30	Goodland	−20	23	1.90	−0.13	Caruthersville	5.55	Albany	0.41
Montana	25.4	+6.9	Fort Shaw	67	[2]13	Plevna	−27	22	0.59	−0.35	Heron	3.44	3 stations	T.
Nebraska	26.6	+4.7	Alma	70	29	Gordon	−21	22	0.91	+0.36	Chadron	2.66	Stapleton	0.07
Nevada	31.1	+1.1	Beatty	78	2	Millett	−10	27	0.51	−0.56	Carson City	1.50	6 stations	0.00
New England	22.6	+1.7	2 stations	59	19	Van Buren, Me	−29	26	2.65	−0.67	Eastport, Me	4.11	Springfield, Mass	1.09
New Jersey	30.8	+0.6	2 stations	63	20	Newton	−9	29	2.61	−1.04	Highwood	4.04	Boonton	1.63
New Mexico	29.1	−4.1	Deming	78	29	Estancia	−24	24	0.66	+0.09	Cloverdale	2.88	Clayton	0.05
New York	24.3	+1.8	Ohioville	56	19	Tupper Lake	−31	29	2.39	−0.56	McKeever	5.54	Chazy	1.04
North Carolina	40.1	−1.2	Greenville	75	18	Parker	−3	23	5.27	+1.32	Highlands	10.11	Louisburg	2.88
North Dakota	16.3	+11.3	Steele	55	17	2 stations	−30	28	0.38	−0.16	Hettinger	1.10	Hansboro	0.00
Ohio	27.2	−1.1	Portsmouth	64	20	McArthur	−22	29	2.39	−0.69	Portsmouth	4.44	Bowling Green	0.85
Oklahoma	37.9	−0.7	Erick	72	19	Watts	−10	22	2.24	+0.80	Antlers	9.01	Hooker	0.02
Oregon	35.4	+1.9	Port Oxford	70	7	Ukiah	−12	27	2.85	−1.73	Brookings	9.49	Vale	0.14
Pennsylvania	27.8	0.0	Gettysburg	66	20	2 stations	−19	29	2.80	−0.53	Harrisburg	4.85	Pennline	1.12
South Carolina	44.1	−1.4	2 stations	76	[2]7	Caesars Head	12	14	6.18	+2.52	Walhalla	9.52	Kershaw	4.47
South Dakota	19.8	+4.0	do	58	[2]13	La Delle	−36	22	1.20	+0.57	Harvey's Ranch	3.85	Aberdeen	0.09
Tennessee	38.3	−0.9	Clarksville	69	20	Crossville	−4	14	4.31	−0.70	Kenton	7.31	Greeneville	1.77
Texas	44.7	−3.8	2 stations	88	[2]17	Clarendon	−3	21	3.11	+1.28	Conroe	8.29	Muleshoe	0.00
Utah	24.9	+0.1	Saint George	63	9	Woodruff	−24	28	0.56	−0.83	Silver Lake	2.61	5 stations	0.00
Virginia	35.7	−0.6	Hopewell	72	2	Burkes Garden	−6	14	3.72	+0.43	Langley Field	6.19	Winchester	1.19
Washington	34.5	+3.4	Forks	62	28	Snyders Ranch	0	[2]19	3.98	−1.11	Paradise Inn	16.86	Moxee (near)	0.42
West Virginia	29.7	−2.5	2 stations	66	17	Mannington	−23	29	3.71	−0.24	Pickens	7.74	Moorefield	1.78
Wisconsin	16.4	+2.4	3 stations	49	[2]18	Solon Springs	−33	28	0.75	−0.54	Mondovi	2.22	Mather	0.14
Wyoming	19.7	+0.3	Sundance	56	2	Foxpark	−29	22	0.81	+0.05	Hunter's station	3.12	Powell	0.05
Alaska (December)	17.5	−4.6	Wrangell	60	8	Allakaket	−60	[2]9	7.88	−1.83	Ketchikan	34.13	Tanana	0.19
Hawaii	70.1	+1.7	Waialua Mill	91	14	Volcano Observatory	45	28	3.43	−5.99	Puohakamoa	14.50	3 stations	0.00
Porto Rico	74.8	+1.6	Comerio Falls	93	3	Aibonito	52	[2]16	2.80	−0.88	Dorado	12.33	Santa Isabel	0.09

[1] For description of tables and charts, see REVIEW, January, 1926, p. 32.

[2] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau stations, January, 1926*

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0-10	In.	In.
New England							26.6	+2.1										75	2.75	-0.7										6.3		
Eastport	76	67	85	29.70	29.88	-.12	21.3	+0.9	44	19	29	-8	22	14	34	20	17	82	4.11	+0.3	16	9,247	w.	44	nw.	29	7	3	21	7.3	23.1	8.2
Greenville, Me.	1,070	6		28.68	29.90		13.4		35	18	23	-16	29	4	39				3.37		16	5,825	nw.	36		7	10	4	17		26.5	
Portland, Me.	103	82	117	29.82	29.95	-.10	24.0	+1.6	48	19	31	0	29	17	29	22	16	71	3.38	-0.4	12	6,318	n.	36	nw.	28	10	8	13	5.7	12.6	4.1
Concord	289	70	79	29.61	29.93	-.12	22.8	+1.2	47	6	32	-7	11	13	43				2.30	-1.0	10	4,161	nw.	31	nw.	19	15	9	7	4.4	10.7	0.5
Burlington	403	11	48	29.50	29.97	-.08	19.8	+1.0	41	5	28	-13	29	12	31				2.01	+0.2	12	9,322	s.	44	w.	7	5	5	21	7.8	12.3	2.1
Northfield	876	12	60	28.97	29.96	-.09	18.2	+3.0	46	6	28	-14	29	8	48	15	13	84	2.23	-0.3	13	4,957	n.	32	sw.	28	3	8	20	7.9	13.7	6.2
Boston	125	115	188	29.81	29.95	-.10	31.0	+3.1	56	18	38	4	29	24	32	27	20	63	2.53	-1.3	8	8,373	sw.	43	s.	18	9	7	15	6.2	7.4	T.
Nantucket	12	14	90	29.94	29.95	-.09	32.2	+0.9	50	18	39	8	29	26	30	30	26	80	2.84	-0.6	11	13,274	w.	54	nw.	28	9	9	13	6.6	5.6	0.0
Block Island	26	11	46	29.94	29.96	-.11	32.3	+1.3	54	18	38	8	29	27	30	30	25	74	2.61	-1.2	10	16,828	w.	72	nw.	22	11	6	14	6.1	0.9	0.0
Providence	160	215	251	29.79	29.98	-.08	30.2	+3.0	53	18	38	3	29	23	31	27	21	70	2.69	-1.7	11	9,969	nw.	74	w.	29	9	8	14	5.8	4.8	0.0
Hartford	159	122		29.81	29.99	-.08	29.7	+4.2	53	18	37	2	29	22	27				2.85	-1.0	11		sw.				8	11	12	5.7	5.2	0.0
New Haven	106	74	153	29.88	30.00	-.08	30.6	+2.4	53	18	38	3	29	24	30	28	23	75	2.66	-1.2	8	7,311	sw.	44	nw.	28	8	10	13	5.8	5.6	0.0
Middle Atlantic States							33.0	+0.9										72	3.23	0.0										6.2		
Albany	97	102	115	29.88	30.00	-.07	25.8	+2.7	45	6	33	0	29	18	34	23	20	80	2.35	-0.2	10	5,497	s.	30	w.	28	7	13	11	6.0	11.9	1.3
Binghamton	871	10	84	29.03	30.00	-.08	26.2	+2.1	50	5	34	-3	13	19	33				2.96	+1.0	12	5,176	w.	34	w.	28	1	9	21	7.9	19.7	T.
New York	314	414	454	29.67	30.02	-.08	31.8	+0.9	54	18	39	4	29	25	28	28	21	66	2.52	-1.3	10	14,756	nw.	84	nw.	28	7	8	16	6.8	3.2	0.0
Harrisburg	374	94	104	29.64	30.06	-.04	29.6	+0.6	54	20	37	5	29	22	26	26	21	71	4.85	+2.0	10	5,160	nw.	35	nw.	22	4	14	13	6.2	7.3	T.
Philadelphia	114	123	190	29.92	30.05	-.06	34.3	+1.7	60	18	41	7	29	28	29	30	24	68	2.85	-0.6	10	7,565	sw.	39	ne.	9	9	11	11	5.6	2.2	0.0
Reading	325	81	98	29.69	30.06		31.2		58	18	38	6	29	24	27	28	24	78	3.67	+0.2	10	4,958	nw.	33	nw.	28	7	11	13	6.4	5.0	T.
Scranton	805	111	119	29.13	30.02	-.07	27.2	+0.6	53	18	35	-3	29	20	29	25	22	82	2.09	-0.7	13	5,180	s.	40	w.	28	2	7	22	8.2	12.2	T.
Atlantic City	52	37	172	29.98	30.04	-.07	34.2	+1.7	57	19	41	7	29	27	31	31	26	75	3.11	-0.3	12	14,354	w.	72	e.	9	8	11	12	5.5	0.3	0.0
Cape May	17	13	49	30.06	30.08	-.04	34.6	+0.5	59	20	41	10	29	28	29	31	28	79	2.25	-1.1	11	6,963	w.	40	e.	9	10	11	10	5.5	0.5	0.0
Sandy Hook	22	10	55	29.99	30.02		31.5		51	18	37	6	29	26	30	28	23	71	2.45		11	13,192	w.	60	nw.	28	6	11	14	6.4	2.0	0.0
Trenton	190	159	183	29.82	30.03		32.2		58	18	40	4	29	25	33	28	21	66	2.25	-0.9	10	9,073	sw.	48	nw.	28	8	8	15	6.5	3.8	0.0
Baltimore	123	100	113	29.92	30.05	-.07	34.5	+0.7	64	20	42	8	29	27	33	30	24	67	3.10	-0.1	9	4,401	sw.	27	ne.	8	10	9	12	5.5	3.1	0.0
Washington	112	62	85	29.93	30.06	-.07	33.8	+0.4	62	18	42	7	29	25	34	29	23	68	3.60	+0.2	10	5,080	nw.	35	nw.	28	9	10	12	5.6	3.4	0.0
Cape Henry	18	8	54	30.04	30.06		40.6		69	21	49	19	29	32	35	36	32	78	4.56	+1.2	9	10,132	sw.	65	n.	22	7	12	12	6.1	6.2	0.0
Lynchburg	681	153	188	29.31	30.07	-.06	38.0	+0.5	68	20	48	15	29	28	38	32	24	61	3.89	+0.2	11	6,385	w.	40	nw.	22	9	10	12	5.9	5.5	0.0
Norfolk	91	170	205	29.98	30.08	-.05	41.6	+1.0	67	18	50	16	29	33	37	36	31	72	4.52	+1.2	10	10,743	sw.	54	n.	22	9	9	13	5.8	8.3	0.0
Richmond	144	11	52	29.92	30.08	-.05	37.8	-0.1	69	18	48	10	29	28	39	33	27	70	3.30	+0.3	12	6,708	sw.	40	ne.	22	12	10	9	5.1	5.6	0.0
Wytheville	2,304	49	55	27.62	30.08	-.06	32.3	-0.7	57	18	40	7	14	24	35	28	24	77	3.09	-1.2	19	6,454	w.	38	w.	28	6	8	17	6.8	7.3	0.0
South Atlantic States							45.3	-0.3										78	5.59	+2.0										6.6		
Asheville	2,253	70	84	27.66	30.10	-.05	37.0	+1.6	63	20	46	15	1	29	38	32	28	73	3.39	+0.5	11	7,032	nw.	39	n.	22	9	8	14	6.1	2.5	0.0
Charlotte	779	55	62	29.23	30.09	-.06	41.0	-0.2	67	20	49	21	10	33	31	37	33	79	5.47	+1.2	12	4,133	sw.	29	w.	28	8	4	19	6.5	2.8	0.0
Hatteras	11	11	50	30.06	30.07	-.07	45.6	-1.5	66	22	52	28	29	39	30	43	40	84	7.96	+3.0	12	11,482	sw.	50	s.	18	8	6	17	6.5	0.0	0.0
Raleigh	376	103	110	29.67	30.09	-.04	41.2	+0.1	68	18	50	18	26	33	34	37	33	79	4.29	+0.7	11	6,505	sw.	39	nw.	22	6	7	18	7.0	5.4	0.0
Wilmington	78	81	91	30.02	30.11	-.03	46.6	+0.1	70	20	55	26	1	38	31	42	39	81	5.01	+1.5	11	5,482	w.	31	sw.	22	7	7	17	6.6	0.0	0.0
Charleston	48	11	92	30.06	30.10	-.05	48.6	-1.3	71	21	56	31	1	41	27	44	40	80	5.02	+1.6	12	7,215	w.	42	ne.	7	6	5	20	7.0	0.0	0.0
Columbia, S. C.	351	41	57	29.72	30.11	-.04	45.6	-0.4	70	20	54	23	1	37	32	40	35	73	6.11	+2.8	13	5,730	sw.	34	s.	21	6	12	13	6.3	0.0	0.0
Due West	711	10	55	29.34	30.13		42.4		66	21	51	21	1	34	33				6.12		12	7,551	sw.	40	s.	21	8	5	18	6.5	0.2	0.0
Greenville, S. C.	1,039	139	146	28.96	30.08		42.0	+1.7	65	19	50	23	10	34	33	37	32	75	7.73		12	7,468	sw.	40	ne.	8	9	8	14	6.2	2.4	0.0
Augusta	182	62	77	29.91	30.11	-.05	46.5	-0.5	72	21	55	25	1	38	31	42	38	81	8.13	+4.0	14	4,233	w.	25	w.	27	8	8	15	6.4	0.0	0.0
Savannah	65	150	194	30.03	30.10	-.05	49.8	-1.6	75	5	58	30	14	42	28	45	40	77	5.67	+2.5	14	8,904	w.	40	w.	22	7	6	18	6.7	0.0	0.0
Jacksonville	43	209	245	30.06	30.11	-.04	54.2	-1.2	77	5	61	32	14	47	26	49	45	77	4.89	+1.8	11	8,750	sw.	37	nw.	31	5	7	19	7.4	0.0	0.0
Florida Peninsula							65.7	0.0										81	5.01	+2.5										6.0		
Key West	22	10	64	30.05	30.07	-.03	69.9	+0.4	84	6	75	52	15	65	17	65	63	85	2.51	+0.5	9	7,008	ne.	31	sw.	8	14	9	8	4.6	0.0	0.0
Miami	25	71	79	30.07	30.10		67.6	+0.3	81	31	74	40	14	62	25	62	59	79	7.93	+5.2	9	5,276	se.	30	se.	29	6	12	13	6.1	0.0	0.0
Tampa	35	79	87	30.06	30.10	-.02	59.6	-0.8	80	5	67	37	14	52	25	54	51	80	4.59	+1.8	11	4,519	ne.	30	e.	29	7	6	18	7.3	0.0	0.0
Titusville	44	5		30.06	30.10		59.2		84	5	68	31	15	50	34				4.90		12		sw.				12	3	16	5.8	0.0	0.0
East Gulf States							47.1	-1.1										77	7.73	+2.7										7.1		
Atlanta	1,173	190	216	28.84	30.11	-.04	42.6	0.0	66	20	50	22	23	36	35	38	33	73	7.31	+2.0	14	8,540	nw.	48	nw.	22	3	5	23	8.0	0.4	0.0
Macon	370	78	87	29.71	30.12	-.04	45.8	-1.0	69	20	54	24	1	37	35	41	36	75	6.12	+0.9	15	4,554	nw.	26	nw.	22	5	7	19	7.3	0.0	0.0
Thomasville	273	49	58	29.80	30.11	-.05	50.8	-0.2	73	20	59	30	14	43	33	45	42	79	8.89	+4.8	16	3,597	sw.	21	sw.	18	4	7	20	7.6	0.0	0.0
Apalachicola	36	42	49	30.06	30.10		52.0		70	6	58	35	23	46	29	48	46	84	5.38		15	6,415	n.	31	e.	7	6	10	15	6.7	0.0	0.0
Pensacola	56	149	185	30.05	30.11	-.03	50.5	-2.0	70	4	56	30	23	44	33	47	44	83	7.69	+3.6	12	9,654	n.	52	nw.	31	5	6	20	7.2	T.	0.0
Anniston	741	9	57	29.33	30.14	-.02	42.6	+0.4	68	21	51	20	14	34	28				7.94	+2.6	14	4,209	nw.	26	e.	7	4	10	17	7.2	T.	0.0
Birmingham	700	11	48	29.34	30.13	-.03	43.9	-1.2	69	21	52	22	23	36	31	39	34	72	6.60	+1.3	13	5,104	n.	40	se.	17	3	8	20	7.4	1.0	0.0
Mobile	57	125	161	30.04	30.11	-.04	50.4	-1.1	71	21	58	30	23	43	32	45	41	78	9.49	+4.6	12	7,163	n.	37	se.	17	4	12	15	6.9	0.0	0.0
Montgomery	223	100	112	29.88	30.14	-.02	47.0	-1.2	73	21	54	27	23	40	25	42	38	75	10.32	+5.2	13	5,123	ne.	29	sw.	21	6	6	19	7.4	0.0	0.0
Corinth	469	6					41.4		64	19	51	14	23	32	35				3.00		9		s.				5	16	10		3.0	0.0
Meridian	375	85	93	29.71	30.12	-.04	45.4	-1.6	72	21	54	24	23	37	32	41	36	74	7.81	+2.3	13	4,145	ne.	31	w.	21	7	7	17	6.9	0.0	0.0
Vicksburg	247	65	73	29.85	30.14	-.01	46.7	-1.5	71	21	54	23	23	39	34	41	35	70	6.78	+1.1	10	5,276	se.	32	nw.	21	8	7	16	6.5	T.	0.0
New Orleans	53	76	84	30.05	30.11	-.02	52.0	-2.2	77	21	59	34	23	45	25	47	44	80	6.10	-1.5	14	5,121	ne.	29	sw.	17	7	12	2	6.5	0.0	0.0
West Gulf States							46.4	-1.8										77	3.50	+0.4										5.9		
Shreveport	249	77	93	29.84	30.12	-.02	46.5	-0.5	70	19	54	26	23	39	33	41	37	73	3.05	-1.4	10	4,642	se.	24	nw.	21	13	2	16	5.6	2.8	0.0
Bentonville	1,303	11	44				35.8	+1.7	60	16	45	-7	23	27	37				2.51		12	4,296	s.	27	s.	30	13	8	10		10.2	0.0
Fort Smith	457	79	94	29.60	30.09	-.05	39.8	+0.3	69	19	48	13	23	31	30	35	31	75	3.67	+1.2	8	6,325	e.	28	w.	31	9	8	14	5.8	2.3	0.0
Little Rock	357	136	144	29.71	30.10	-.05	41.5	+0.1	67	19	49	16	22	34	31	37	31	69	4.42	-0.4	10	6,304	s.	34	n.	21	12	7	12	5.8	0.2	0.0
Brownsville	57	53	61	30.03	30.09		55.0	-4.8	77	31	62	33	25	48	27	50	47	82	2.72		12	6,445	n.	32	s.	21	7	8	16	6.5	0.0	0.0
Corpus Christi	20	11	73	30.09	30.11	+.01	51.8	-4.2	73	18	59	32	23	45	29	47	45	83	0.96	-1.3	14	8,062	w.	38	n.	12	8	6	17	6.6	1.5	0.0
Dallas	512	109	117	29.56	30.12		43.7		67	19	52	20	23	36	33				3.77		11	5,594	s.	40	nw.	31	14	6	11	5.0	1.1	0.0
Fort Worth	670	106	114	29.37	30.10	-.02	44.8	-0.6	71	30	54	13	25	36	33	38	32	72	4.04	+2.5	10	6,609	nw.	36	w.	31	14	6	11	5.3	4.2	0.0
Galveston	54	106	114	30.07	30.13	.00	50.0	-3.8	66	18	55	31	23	45	29	47	44	86	4.36	+0.7	15	7,625	n.	40	nw.	21	10	4	17	6.5	0.1	0.0
Groesbeck	461	11	56	29.61	30.11		43.6		70	19	52	18	25	36	30				4.17		9	7,379	n.	34	nw.	21	13	3	15	5.7	4.3	0.0
Houston	138	111	121	29.96	30.12		50.8	-2.1	70	20	58	30	24	44	32				4.93		13	5,214	n.	33	se.	20	9	6	16	6.3	0.8	0.0
Palestine	510	64	72	29.57	30.12	.00	45.2	-3.0	68	19	53	25	22	38	27	40	35	73	4.10	+0.2	8	5,406	nw.	28	nw.	31	9	8	14	5.8	2.2	0.0
Port Arthur	34	58	66	30.07	30.11		49.8		68	21	56	29	23	43	31	46	43	83	4.22		14	5,632	n.	34	s.	21	9	6	16	6.4	1.6	0.0
San Antonio	693	119	132	29.37	30.11	+.01	50.2	-2.1	75	19	59	26	23	41	33	44	41	76	3.42	+1.7	10	5,882	nw.	39	nw.	21	12	5	14	5.4	6.4	0.0
Taylor	583	55	63	29.52	30.15	+.04	45.5	-2.0	70	19	54	18	25	37	30				3.50	+0.7	8	6,187	n.	32	w.	16	10	9	12	5.7	4.8	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, January, 1926*—Continued

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature: Departure from normal	Temperature: Maximum	Temperature: Date	Temperature: Mean maximum	Temperature: Minimum	Temperature: Date	Temperature: Mean minimum	Temperature: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with .01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0–10	In.	In.
Ohio Valley and Tennessee							**33.4**	**−0.2**										**77**	**3.68**	**−0.1**										**6.8**		
Chattanooga	762	189	213	29.28	30.11	−.05	40.5	−0.7	65	5	48	17	23	33	25	36	30	69	5.71	+0.2	13	5,401	sw.	34	nw.	21	5	8	18	6.9	6.2	0.0
Knoxville	995	102	111	29.02	30.10	−.05	38.4	−0.4	63	5	45	17	23	31	28	35	31	74	4.06	−0.9	11	5,209	sw.	32	sw.	18	7	7	17	6.8	3.6	0.0
Memphis	399	76	97	29.67	30.11	−.05	41.4	+0.5	64	19	48	16	23	34	35	37	32	74	4.73	−0.5	8	6,021	sw.	35	sw.	17	8	8	15	5.8	1.2	0.0
Nashville	546	168	191	29.52	30.12	−.04	39.6	+1.0	63	20	48	12	23	31	34	35	30	73	4.48	−0.4	8	6,495	w.	34	nw.	21	11	8	12	5.6	2.8	0.0
Lexington	989	193	230	29.01	30.12	−.01	32.0	−0.9	59	20	39	5	23	25	39	----	----	----	4.43	+0.6	15	11,200	sw.	54	w.	27	9	4	18	6.6	9.6	0.0
Louisville	525	188	234	29.51	30.11	−.03	33.7	−0.7	59	20	41	3	23	26	38	30	25	73	3.73	−0.2	10	8,494	s.	42	w.	27	10	6	15	6.0	10.3	0.0
Evansville	431	139	175	29.62	30.11	−.03	34.3	+0.8	59	19	42	5	23	27	34	31	27	76	3.49	−0.2	11	8,461	sw.	40	w.	27	7	12	12	5.9	10.4	0.0
Indianapolis	822	194	230	29.15	30.07	−.05	28.6	+0.2	51	30	35	0	28	22	40	27	23	80	2.72	−0.1	15	9,917	sw.	48	w.	27	7	9	15	6.6	8.5	0.0
Royal Center	736	11	55	29.23	30.06	------	25.4	------	50	30	33	−7	28	18	48	----	----	----	1.64	------	12	9,181	sw.	46	w.	27	3	12	16	7.5	7.0	0.0
Terre Haute	575	96	129	29.43	30.07	------	29.8	------	52	19	37	2	28	23	36	28	24	81	2.92	------	11	8,095	s.	37	nw.	27	5	10	16	6.9	6.8	0.0
Cincinnati	627	11	51	29.38	30.09	−.03	30.2	−0.1	53	30	38	−1	29	23	45	----	26	85	2.65	−0.7	12	6,975	sw.	36	w.	27	8	7	16	6.5	12.4	T.
Columbus	822	179	222	29.15	30.06	−.05	28.2	−0.4	53	18	35	−5	29	21	36	25	22	79	2.52	−0.4	14	8,591	s.	52	nw.	28	5	4	22	7.6	11.9	T.
Dayton	899	137	173	29.07	30.06	------	28.8	−0.7	51	18	36	−3	29	22	41	26	22	76	2.25	−0.8	13	8,288	sw.	47	w.	27	6	12	13	6.5	12.1	T.
Elkins	1,947	59	67	27.96	30.11	−.01	30.0	−0.4	60	18	40	−13	29	20	56	26	22	80	4.20	+0.9	18	4,908	w.	39	sw.	28	5	5	21	7.8	11.5	T.
Parkersburg	637	77	82	29.41	30.09	−.03	31.1	−1.4	60	5	39	−5	29	23	36	27	23	78	3.71	+0.5	14	4,567	sw.	44	nw.	28	6	6	19	7.3	18.4	0.2
Pittsburgh	842	353	410	29.12	30.06	−.05	30.4	−0.3	56	5	37	−3	29	24	34	27	23	75	2.85	0.0	16	9,896	sw.	52	w.	28	5	2	24	8.0	14.0	1.0
Lower Lake Region							**25.7**	**+1.3**										**79**	**2.13**	**−0.5**										**7.8**		
Buffalo	767	247	280	29.12	29.98	−.09	25.2	+0.6	45	17	31	−2	29	20	30	24	21	83	2.53	−0.8	17	16,890	sw.	72	w.	28	1	9	21	8.3	18.4	T.
Canton	448	10	61	29.43	29.94	------	18.8	+2.5	42	5	28	−19	29	10	32	----	----	----	1.55	−1.6	18	8,739	sw.	41	w.	28	4	8	19	7.8	8.0	0.8
Oswego	335	76	91	------	29.98	−.09	25.0	+1.1	46	5	32	−7	29	19	30	----	----	84	2.13	−1.0	20	9,589	s.	47	nw.	28	1	5	25	----	48.2	11.0
Rochester	523	86	102	29.40	29.99	−.08	26.6	+2.0	49	5	32	0	29	21	28	24	19	74	1.99	−1.1	20	8,396	sw.	45	w.	28	1	6	24	8.5	14.7	T.
Syracuse	597	97	113	29.33	29.99	−.08	26.6	+3.6	49	5	33	1	29	20	24	----	----	----	3.02	+0.9	18	9,950	s.	54	sw.	28	0	11	20	8.0	23.3	3.0
Erie	714	130	166	29.21	30.00	−.08	27.2	+0.4	50	18	33	−2	29	21	39	24	20	76	1.82	−1.2	16	12,994	s.	49	s.	23	0	9	22	8.2	11.8	T.
Cleveland	762	190	201	29.17	30.02	−.07	27.2	+0.7	52	18	34	−6	29	20	41	25	21	78	1.78	−0.7	17	12,696	s.	50	w.	28	2	5	24	8.3	9.5	0.0
Sandusky	629	62	70	29.33	30.04	−.05	27.2	+0.9	50	18	34	−5	29	21	42	----	----	----	1.79	−0.3	16	7,896	sw.	35	nw.	28	5	7	19	7.4	8.7	0.0
Toledo	628	208	243	29.32	30.03	−.06	26.8	+1.0	49	30	34	−5	29	20	42	24	20	76	2.46	+0.5	15	12,746	sw.	57	w.	27	7	6	18	6.9	9.9	0.0
Fort Wayne	856	113	124	29.06	30.02	------	27.1	−0.2	51	30	34	−5	29	20	44	25	22	82	1.75	------	12	8,709	sw.	36	sw.	23	3	11	17	7.4	7.5	T.
Detroit	730	218	258	29.18	30.01	−.07	25.4	+1.0	46	30	32	−4	29	19	37	23	20	81	2.23	+0.2	15	9,329	sw.	46	sw.	23	5	9	17	7.1	15.6	T.
Upper Lake Region							**20.7**	**+2.0**										**85**	**1.18**	**−0.8**										**7.6**		
Alpena	609	13	92	29.26	29.96	−.08	21.6	+2.5	43	30	29	−7	28	15	37	20	18	85	0.64	−1.6	13	9,244	sw.	52	nw.	28	0	10	21	8.3	6.0	T.
Escanaba	612	54	60	29.26	29.96	−.09	17.2	+1.8	39	2	24	−13	28	10	37	16	14	86	0.60	−1.0	13	7,654	sw.	38	n.	11	10	7	14	5.9	5.5	1.0
Grand Haven	632	54	89	29.27	29.98	−.09	25.2	+0.9	43	30	31	−1	28	19	31	24	22	85	1.30	−1.5	18	10,637	sw.	59	w.	23	3	4	24	8.4	15.1	0.2
Grand Rapids	707	70	87	29.20	30.00	−.06	25.6	+1.1	45	16	32	−1	28	19	41	24	20	80	1.77	−1.0	13	5,437	nw.	31	nw.	23	2	3	26	8.8	15.5	T.
Houghton	668	62	99	29.18	29.94	−.11	16.4	+1.7	36	17	23	−14	28	9	28	----	----	----	1.74	−0.3	17	8,413	w.	48	w.	23	0	5	26	9.2	17.0	10.0
Lansing	878	11	62	29.01	29.98	------	23.4	+1.0	44	17	31	−3	28	16	43	23	21	92	1.88	−0.2	20	6,027	sw.	32	nw.	24	4	10	17	7.3	12.9	T.
Ludington	637	60	66	29.25	29.97	------	24.0	------	40	31	30	−6	28	18	30	24	22	87	1.15	------	19	10,178	w.	55	sw.	23	2	6	23	8.3	10.3	1.0
Marquette	734	77	111	29.10	29.94	−.10	18.6	+2.3	41	2	25	−14	28	12	35	16	14	86	0.89	−1.2	15	8,699	w.	41	sw.	23	1	9	21	8.2	8.1	9.1
Port Huron	638	70	120	29.27	29.98	−.08	23.8	+1.5	43	30	30	−5	29	17	31	22	20	87	1.66	−0.2	14	9,996	sw.	45	nw.	28	5	6	20	7.1	18.0	T.
Saginaw	641	----	----	29.26	29.98	------	23.0	+1.3	42	17	30	−8	12	16	41	----	----	----	0.75	------	15	------	sw.	----	----	----	6	6	19	----	9.1	T.
Sault Sainte Marie	614	11	52	29.21	29.94	−.06	16.4	+3.1	36	5	24	−21	28	8	37	16	13	87	1.46	−0.7	17	6,570	se.	40	nw	6	1	7	23	8.4	13.4	7.8
Chicago [1]	673	7	131	29.28	30.04	−.06	26.4	+2.7	49	30	33	−5	28	19	38	24	21	79	1.35	−0.6	11	10,455	sw.	43	nw.	27	7	8	16	6.7	3.9	0.0
Green Bay	617	109	141	29.28	29.98	−.08	17.8	+2.1	40	14	26	−16	28	10	43	17	15	87	0.53	−1.2	11	9,348	sw.	43	sw.	23	6	11	14	6.6	2.8	0.1
Milwaukee	681	125	139	29.23	29.99	−.09	23.0	+2.4	46	30	31	−14	28	16	44	21	18	79	0.97	−1.0	11	8,596	sw.	39	sw.	23	6	9	16	6.6	8.5	0.0
Duluth	1,133	5	47	28.70	29.98	−.11	11.4	+3.5	37	2	20	−30	28	3	36	10	9	91	0.49	−0.5	8	11,559	nw.	70	nw.	22	9	3	19	6.7	3.9	4.1
North Dakota							**16.6**	**+12.0**										**82**	**0.51**	**−0.1**										**5.7**		
Moorhead	940	50	58	28.96	30.03	−.11	14.3	+10.5	45	29	25	−23	28	4	39	13	10	83	0.66	0.0	11	7,140	n.	31	n.	12	5	7	19	7.1	7.7	3.3
Bismarck	1,674	8	57	28.22	30.09	−.04	18.6	+10.8	54	17	30	−15	28	8	37	17	14	81	0.54	0.0	6	6,760	nw.	34	nw	12	13	7	11	4.8	8.6	4.0
Devils Lake	1,478	11	44	28.36	30.01	−.11	14.2	+13.9	44	17	25	−17	28	3	39	12	10	84	0.16	−0.4	6	7,415	sw.	38	n.	12	11	12	8	5.2	2.5	1.4
Ellendale	1,457	10	56	28.40	30.03	------	16.6	------	52	17	29	−16	28	5	43	----	----	----	0.22	------	7	11,297	nw.	50	nw.	12	7	8	16	6.3	2.5	0.5
Grand Forks	835	12	89	------	------	------	12.4	------	43	2	24	−26	28	1	44	11	----	----	0.45	------	8	------	s.	48	ne.	10	10	4	17	----	4.5	4.1
Williston	1,878	41	48	27.98	30.04	−0.7	19.4	+13.0	47	17	30	−12	28	9	40	17	14	82	0.68	+0.1	6	6,087	sw.	27	nw.	23	12	8	11	5.1	7.0	5.2
Upper Mississippi Valley							**25.0**	**+3.6**										**80**	**1.32**	**−0.4**										**6.3**		
Minneapolis	918	102	208	28.97	30.00	------	17.0	+4.3	39	2	26	−19	28	8	34	----	----	----	0.71	0.0	7	8,795	nw.	44	nw.	27	6	10	15	6.4	7.9	2.2
St. Paul	837	236	261	29.07	30.02	−.09	16.2	+3.5	38	18	25	−20	28	7	35	----	----	----	0.97	+0.1	8	9,338	nw.	50	nw.	27	4	16	11	6.4	10.5	3.6
La Crosse	714	11	48	29.22	30.03	−.08	18.2	+2.1	42	16	27	−17	28	9	38	----	----	----	0.91	−0.2	7	4,182	se.	28	s.	23	4	12	15	6.6	6.4	6.0
Madison	974	70	78	28.93	30.03	−.07	19.6	+2.9	42	30	27	−17	28	12	41	19	16	86	0.76	−0.8	6	7,248	nw.	33	sw.	23	7	8	16	6.3	6.0	0.6
Wausau	1,247	4	----	28.59	29.99	------	14.5	------	37	30	23	−22	28	6	37	----	----	----	0.67	------	7	------	s.	----	----	----	6	7	18	7.2	3.8	1.8
Charles City	1,015	10	49	28.92	30.04	−.10	17.8	+4.1	40	30	27	−15	28	8	45	16	14	88	1.09	+0.1	8	5,277	nw.	27	nw.	5	8	11	12	5.9	4.8	2.5
Davenport	606	71	79	29.37	30.06	−.06	25.8	+4.0	56	30	34	−9	22	17	38	24	20	81	0.94	−0.6	9	5,747	w.	28	nw.	27	9	6	16	6.3	6.1	0.0
Des Moines	861	84	97	29.11	30.06	−.08	25.4	+5.3	50	30	34	−5	22	16	38	23	19	79	0.95	−0.3	11	5,540	n.	31	sw.	29	8	7	16	6.4	4.3	T.
Dubuque	700	81	96	29.24	30.02	−.10	22.2	+3.1	48	30	30	−13	12	14	36	21	17	81	1.40	−0.1	7	5,313	nw.	35	nw.	27	7	7	17	6.7	7.4	T.
Keokuk	614	64	78	29.38	30.08	−.06	28.8	+3.9	56	30	37	−6	22	20	37	26	21	74	1.03	−0.7	12	6,731	nw.	32	nw.	27	8	8	15	6.4	5.8	0.0
Cairo	358	87	93	29.70	30.10	−.06	36.8	+1.9	62	19	44	8	22	29	32	32	28	74	3.50	−0.3	9	7,038	s.	38	n.	21	12	4	15	5.7	6.0	0.0
Peoria	609	11	45	29.38	30.07	−.05	26.9	+3.8	53	19	35	−7	22	19	38	24	22	84	1.39	−0.8	11	5,787	s.	29	nw.	27	9	8	14	6.1	4.8	0.0
Springfield, Ill	636	10	91	29.36	30.06	−.07	29.8	+3.3	54	19	37	−2	22	23	37	27	24	82	1.64	−0.6	12	6,931	s.	27	nw.	27	10	7	14	6.0	2.5	0.0
Hannibal	534	74	109	29.49	30.09	−.04	30.9	+3.8	60	30	39	−5	22	23	33	----	----	----	1.44	−0.8	13	7,277	sw.	29	nw.	27	7	7	17	6.4	6.3	T.
St. Louis	568	265	303	29.45	30.08	−.06	34.6	+3.8	61	19	42	3	22	27	34	30	25	71	1.69	−0.6	8	10,073	sw.	44	nw.	27	10	6	15	6.0	3.1	0.0
Missouri Valley							**26.9**	**+4.3**										**81**	**1.42**	**+0.4**										**5.9**		
Columbia, Mo	784	11	84	29.22	30.08	−.05	32.6	+3.4	63	30	40	0	22	25	32	----	----	----	1.43	−0.8	12	6,924	n.	30	nw.	13	8	7	16	6.4	1.3	0.0
Kansas City	963	161	181	29.01	30.08	−.07	32.4	+4.2	56	30	40	0	22	24	32	30	25	76	1.56	+0.4	12	8,811	sw.	35	n.	13	10	8	13	5.6	4.2	0.0
St. Joseph	976	11	49	29.00	30.07	------	30.0	------	54	18	38	−5	22	22	32	27	24	81	1.45	------	8	6,668	nw.	45	nw.	27	9	9	13	5.6	2.8	0.0
Springfield, Mo	1,324	98	104	28.64	30.09	−.05	34.0	+0.5	62	19	42	1	23	26	27	30	27	78	2.28	−0.4	10	8,225	sw.	36	s.	30	10	10	11	5.4	6.9	0.0
Iola	984	11	50	29.00	30.09	−.05	33.6	+6.0	56	27	42	5	22	25	34	----	----	----	1.84	+0.9	7	5,760	s.	26	s.	30	12	2	17	6.0	1.2	0.0
Topeka	987	92	107	------	------	------	31.2	+3.6	54	18	39	−2	22	23	38	----	----	----	1.12	+0.2	9	7,101	sw.	34	nw.	12	9	9	13	5.9	6.6	0.0
Drexel	1,299	10	54	28.61	30.06	------	24.4	------	47	29	33	−8	22	16	36	----	----	----	0.91	------	7	7,741	nw.	31	sw.	29	7	8	16	6.7	2.9	T
Lincoln	1,189	11	84	28.76	30.08	−.07	28.0	+5.2	53	29	36	−9	22	20	32	25	23	83	0.93	+0.3	9	7,790	n.	37	nw.	11	8	6	17	6.8	4.8	0.0
Omaha	1,105	115	122	28.85	30.08	−.07	26.6	+4.7	51	29	35	−4	22	18	32	24	20	78	0.98	+0.3	9	6,407	nw.	37	n.	12	11	7	13	5.6	4.0	T.
Valentine	2,598	47	54	27.26	30.08	−.04	23.6	+4.7	50	29	34	−9	22	14	31	22	19	81	1.42	+0.9	14	6,826	w.	34	nw.	12	10	11	10	5.3	16.9	2.5
Sioux City	1,135	94	164	28.81	30.08	−.07	22.4	+4.6	42	29	31	−7	22	14	36	21	18	83	1.08	+0.5	9	8,768	nw.	44	nw.	12	8	8	15	6.4	5.0	0.8
Huron	1,306	59	74	28.63	30.10	−.06	16.4	+5.1	40	13	26	−29	22	6	45	15	13	84	1.57	+1.1	9	6,992	nw.	34	n.	11	8	9	14	5.8	16.8	7.0
Pierre	1,572	70	75	28.37	30.10	−.03	20.0	+4.0	43	13	30	−16	23	10	53	19	17	85	1.31	+0.8	7	5,610	nw.	37	nw.	12	10	9	12	5.6	17.8	4.0
Yankton	1,233	49	57	28.68	30.06	−.10	22.4	+5.1	45	29	31	−8	28	14	35	----	----	----	1.50	+0.9	11	6,107	w.	34	nw.	11	9	8	14	6.1	7.6	1.0

[1] Data for Chicago, beginning January, 1926, will be those from the branch office at Chicago University, about 6 miles south of main office.

TABLE 1.—*Climatological data for Weather Bureau stations, January, 1926*—Continued

Districts and stations	Elevation of instruments: Barometer above sea level	Thermometer above ground	Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Departure from normal	Days with .01, or more	Wind: Total movement	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0-10	In.	In.
Northern Slope							24.8	+5.4										75	0.67	-0.2										6.0		
Billings	3,140	5					31.3	----	58	13	42	1	20	21	33	----	----	----	0.33	----	4	----	nw.	----	----	----	17	7	7	----	6.0	T.
Havre	2,505	11	44	27.36	30.08	-.02	26.6	+13.7	49	17	36	-6	22	18	41	25	22	83	0.38	-0.3	6	6,632	sw.	31	sw.	17	8	14	9	5.4	2.1	T.
Helena	4,110	87	112	25.85	30.18	+.03	28.0	+7.8	49	17	36	4	22	20	30	24	19	72	0.19	-0.7	8	5,245	sw.	31	sw.	6	6	11	14	6.7	3.3	T.
Kalispell	2,973	48	56	27.05	30.23	+.11	24.6	+4.2	42	17	30	7	27	20	17	24	22	87	1.15	-0.4	9	2,354	nw.	20	sw.	17	1	6	24	8.6	11.8	4.7
Miles City	2,371	48	55	27.50	30.14	+.02	24.8	+10.3	48	17	34	-11	22	16	34	23	19	76	0.70	+0.1	7	4,075	nw.	30	nw.	6	10	8	13	5.9	7.4	1.0
Rapid City	3,259	50	58	26.58	30.12	+.02	27.8	+5.8	57	13	38	-4	22	18	46	25	20	71	1.13	+0.7	8	5,519	w.	40	nw.	4	11	8	12	5.8	12.2	3.2
Cheyenne	6,088	84	101	23.94	30.11	+.06	25.9	+0.4	48	29	34	1	22	18	24	22	16	68	0.88	+0.5	9	12,549	nw.	56	w.	13	8	11	12	5.7	9.0	0.4
Lander	5,372	60	68	24.66	30.28	+.16	14.4	-3.9	38	30	26	-15	23	3	31	12	6	71	1.06	+0.6	6	2,013	sw.	34	ne.	6	11	11	9	5.3	11.9	9.6
Sheridan	3,790	10	47	26.10	30.13	----	25.7	----	51	13	37	-11	22	14	46	23	19	75	1.05	----	9	3,722	nw.	38	nw.	6	9	9	13	5.7	11.3	2.2
Yellowstone Park	6,241	11	48	23.91	30.28	+.14	20.0	+2.4	38	28	29	-3	20	11	28	17	13	73	0.35	-1.9	13	4,629	s.	32	s.	17	8	12	11	5.7	3.5	4.7
North Platte	2,821	11	51	27.09	30.11	-.01	30.8	+7.9	62	29	40	9	23	22	37	26	22	77	0.22	-0.2	8	5,734	w.	32	nw.	4	11	9	11	5.1	1.0	0.0
Middle Slope							32.6	+2.2										74	0.91	+0.2										5.1		
Denver	5,292	106	113	24.70	30.11	+.06	31.2	+1.4	59	28	41	4	21	21	34	26	19	65	0.77	0.4	7	5,654	s.	31	ne.	6	11	12	8	5.2	11.0	0.0
Pueblo	4,685	80	86	25.28	30.10	+.05	30.0	+0.1	61	29	42	-4	23	18	42	25	19	66	0.83	+0.5	7	3,821	n.	34	nw.	30	14	12	5	4.0	8.3	0.0
Concordia	1,392	50	58	28.56	30.08	-.06	31.0	+4.6	55	27	40	-1	22	22	36	27	23	76	0.59	-0.1	7	5,974	nw.	32	nw.	12	12	6	13	5.5	2.9	0.2
Dodge City	2,509	11	51	27.44	30.13	+.02	33.1	+4.1	63	27	45	7	22	21	41	27	23	76	0.36	-0.1	5	6,911	nw.	35	nw.	31	17	8	6	3.8	0.6	0.0
Wichita	1,358	139	158	28.60	30.08	-.05	33.4	+2.1	60	27	42	5	22	25	30	30	27	80	0.80	0.0	7	10,087	s.	42	s.	30	10	9	12	5.4	1.2	0.0
Broken Arrow	765	11	46	29.25	30.10	----	37.0	----	64	19	46	4	23	28	30	----	----	----	2.64	----	8	9,653	s.	42	s.	30	8	8	15	6.0	6.5	0.0
Oklahoma City	1,214	10	47	28.78	30.10	-.01	37.2	+0.8	64	30	46	10	22	29	29	34	30	81	2.13	+0.8	9	7,685	s.	31	nw.	31	10	7	14	5.8	3.8	0.0
Southern Slope							40.3	-2.0										63	0.91	+0.2										4.5		
Abilene	1,738	10	52	28.26	30.12	+.03	41.4	-2.8	70	30	52	14	25	31	35	35	29	71	1.44	+0.5	9	6,310	s.	30	w.	30	12	8	11	5.0	5.7	0.0
Amarillo	3,676	10	49	26.27	30.09	+.03	36.0	+0.7	68	18	47	9	23	25	43	28	21	60	0.48	-0.1	5	7,155	sw.	30	sw.	30	17	7	7	4.0	4.1	0.0
Del Rio	944	64	71	29.12	30.13	+.07	48.5	-1.7	72	30	58	27	24	30	37	----	----	----	0.85	0.0	3	5,864	nw.	38	nw.	21	13	5	13	5.4	4.7	0.0
Roswell	3,566	75	85	26.39	30.10	+.06	35.2	-4.0	68	18	49	-1	22	21	44	28	20	59	0.88	+0.5	8	4,943	n.	46	n.	6	17	6	8	3.6	6.0	0.0
Southern Plateau							39.4	-1.3										56	0.54	-0.2										2.6		
El Paso	3,778	152	175	26.24	30.11	+.10	40.6	-4.4	64	29	51	13	24	30	35	33	24	58	0.54	0.0	8	6,337	nw.	39	e.	22	19	6	6	3.3	1.7	0.0
Santa Fe	7,013	38	53	23.19	30.14	+.10	25.3	-3.5	47	29	35	2	24	16	27	20	15	71	0.45	-0.1	6	4,209	n.	25	n.	6	20	5	6	3.2	6.1	T.
Flagstaff	6,907	10	59	23.32	30.07	+.02	27.4	+0.7	56	28	42	-1	21	13	52	21	----	62	0.23	----	6	5,295	e.	38	e.	5	19	9	3	----	0.6	0.0
Phoenix	1,108	10	82	28.90	30.08	+.05	49.4	-1.8	72	31	64	26	22	35	42	39	26	45	1.00	-0.2	2	3,257	e.	33	sw.	31	19	10	2	2.7	0.0	0.0
Yuma	141	9	54	29.94	30.08	+.03	52.8	-1.6	73	30	66	33	22	39	37	42	29	44	0.10	-0.3	2	4,071	n.	26	nw.	20	27	4	0	1.4	0.0	0.0
Independence	3,957	5	25	26.04	30.13	+.06	41.2	+3.0	67	7	56	11	27	26	44	30	----	----	0.61	-0.3	1	----	nw.	----	----	----	14	11	6	2.6	0.0	0.0
Middle Plateau							29.3	+1.1										67	0.69	-0.4										4.4		
Reno	4,532	74	81	25.57	30.24	+.11	32.8	+0.3	55	28	45	11	20	20	36	28	22	68	0.91	-0.8	6	3,217	w	50	w.	29	15	8	8	4.1	3.0	T.
Tonopah	6,090	12	20	24.11	30.18	----	32.7	----	48	9	40	12	20	25	22	26	15	48	0.01	----	1	----	nw.	----	----	----	----	----	----	----	----	----
Winnemucca	4,344	18	56	25.76	30.28	+.12	29.0	+0.4	49	31	40	9	13	18	36	26	23	79	0.55	-0.5	6	4,776	ne.	32	s.	29	13	12	6	4.5	3.3	0.0
Modena	5,479	10	43	24.68	30.18	+.08	27.4	+0.7	54	28	41	0	21	13	48	22	14	64	0.38	-0.4	2	5,515	w.	39	sw.	29	19	7	5	3.4	5.5	T.
Salt Lake City	4,360	163	203	25.75	30.25	+.10	28.8	-0.4	44	9	36	10	20	22	23	26	23	78	1.21	-0.1	9	3,310	nw.	30	s.	29	13	4	14	5.5	13.9	1.6
Grand Junction	4,602	60	68	25.47	30.16	+.10	28.4	+4.4	48	1	38	10	21	18	32	24	17	65	0.41	-0.1	6	3,098	se.	18	se.	31	10	15	6	4.4	2.9	0.0
Northern Plateau							30.0	+1.3										84	1.11	-0.5										8.1		
Baker	3,471	48	53	----	30.32	+1.6	23.5	-1.4	42	30	32	6	13	15	25	----	----	86	0.41	-0.9	6	3,763	se.	19	e.	16	6	12	13	----	5.2	T.
Boise	2,739	78	86	27.38	30.33	+.14	30.4	+0.6	49	16	37	17	16	24	32	28	25	77	0.70	-1.2	5	3,104	se.	30	se.	31	11	3	17	6.5	3.6	0.0
Lewiston	757	40	48	29.45	30.29	+.13	35.2	+2.7	52	16	40	22	2	30	20	----	----	----	1.17	-0.4	11	2,114	e.	24	nw.	5	2	4	25	8.4	3.3	0.0
Pocatello	4,477	60	68	25.59	30.29	+.09	24.4	-0.3	40	30	32	1	28	17	32	22	20	83	0.56	-0.1	7	5,644	se.	36	sw.	30	3	12	16	7.1	9.3	2.5
Spokane	1,929	101	110	28.15	30.27	+.15	30.6	+3.1	46	17	34	18	22	27	16	30	28	88	2.35	0.0	13	2,976	n.	24	s.	16	0	1	30	9.6	11.3	2.0
Walla Walla	991	57	65	29.16	30.27	+.12	35.6	+2.9	50	16	40	28	7	32	28	34	32	85	1.48	-0.5	14	2,696	sw.	30	s.	16	1	3	27	9.1	1.8	0.0
North Pacific Coast Region							43.2	+2.9										86	5.35	-1.4										7.8		
North Head	211	11	56	29.88	30.12	+.07	45.8	+3.7	58	8	50	38	18	42	10	43	40	82	7.68	+1.0	18	10,873	e.	80	s.	16	6	4	22	7.6	0.0	0.0
Port Angeles	29	6	53	----	30.14	----	40.4	----	53	28	45	29	13	36	14	----	----	----	3.52	-1.9	17	3,651	s.	23	nw.	18	0	11	20	----	0.0	0.0
Seattle	125	215	250	30.01	30.14	+.09	42.0	+2.5	53	5	47	28	1	37	17	40	38	85	4.67	-0.1	16	5,078	se	38	s.	16	2	9	20	8.1	0.0	0.0
Tacoma	194	172	201	29.93	30.14	+.10	40.6	+1.8	55	16	45	27	13	36	19	----	----	----	4.71	-1.4	16	4,136	s.	33	sw.	16	0	10	21	8.0	0.0	0.0
Tatoosh Island	86	9	53	29.99	30.09	+.11	45.1	+3.9	55	27	48	40	1	43	13	44	43	93	9.36	-2.8	20	14,587	e.	56	e.	31	6	8	17	7.2	0.0	0.0
Yakima	1,071	5	----	----	----	----	32.4	----	51	17	37	20	30	28	26	----	----	----	0.53	----	7	----	ne.	----	----	----	1	5	25	8.8	3.0	T.
Medford	1,425	4	----	----	----	----	37.6	----	59	27	44	21	13	31	32	34	33	85	1.47	----	11	----	se.	----	----	----	1	3	27	----	0.0	0.0
Portland, Oreg.	153	68	106	30.01	30.17	+.09	42.8	+3.4	60	16	48	31	25	38	17	40	39	83	3.64	-3.0	14	4,727	e.	26	e.	27	7	3	21	7.4	0.0	0.0
Roseburg	510	9	57	29.62	30.18	+.08	43.2	+2.0	63	16	48	31	13	38	27	41	37	87	3.87	-1.8	16	1,832	nw.	25	s.	16	2	11	18	7.3	0.0	0.0
Middle Pacific Coast Region							46.5	-1.2										84	4.61	+0.1										5.8		
Eureka	62	73	89	30.10	30.18	+.08	49.4	+2.5	63	27	55	36	20	44	20	47	45	86	4.69	-2.9	14	3,684	se.	31	se.	27		6	18	6.7	0.0	0.0
Point Reyes	490	7	18	29.56	30.08	----	51.3	+1.9	65	12	56	39	10	46	19	----	----	----	2.97	----	8	12,380	n.	72	s.	28	13	8	10	4.6	0.0	0.0
Red Bluff	332	50	56	29.82	30.19	+.07	41.7	-4.1	69	6	50	27	10	33	37	39	36	80	6.57	+2.6	8	3,045	nw.	21	nw.	6	8	13	10	5.7	0.0	0.0
Sacramento	69	106	117	30.11	30.19	+.07	42.0	-3.8	61	26	48	28	15	36	27	40	38	87	3.20	-0.5	8	4,253	se.	36	se.	29	7	6	18	6.8	0.0	0.0
San Francisco	155	208	243	29.99	30.16	+.05	48.0	-1.9	63	22	53	36	11	42	21	44	41	83	5.48	+1.2	7	5,703	n	45	s.	28	8	13	10	5.3	0.0	0.0
San Jose	141	12	110	30.01	30.17	----	46.5	-1.8	67	27	57	28	12	36	33	----	----	----	3.11	+0.1	7	3,706	nw.	33	se.	30	9	14	8	5.3	0.0	0.0
South Pacific Coast Region							53.1	+1.4										64	2.03	-0.8										3.5		
Fresno	327	89	98	29.84	30.20	+.10	43.2	-3.0	67	27	50	30	20	36	29	40	36	79	0.96	-0.6	5	2,791	nw.	20	s.	31	9	4	18	6.7	0.0	0.0
Los Angeles	338	159	191	29.73	30.10	+.02	59.4	+4.8	77	12	69	43	21	50	25	49	40	54	3.06	+0.2	3	4,075	ne.	21	nw.	3	23	6	2	2.2	0.0	0.0
San Diego	87	62	70	29.99	30.09	+.02	56.7	+2.4	78	7	66	40	21	47	30	49	41	60	0.78	-1.2	2	3,476	ne	24	s.	31	20	8	3	2.6	0.0	0.0
San Luis Obispo	201	32	40	29.93	30.15	+.06	53.0	+1.4	78	7	67	32	14	39	44	45	36	60	3.32	-1.4	5	2,652	n.	26	s	31	21	7	3	2.3	0.0	0.0
West Indies																																
San Juan, P. R.	82	9	54	29.95	30.04	----	75.8	+0.8	86	14	81	68	20	71	15	----	----	----	6.62	+2.0	18	8,999	e.	35	e.	30	12	15	4	4.6	0.0	0.0
Panama Canal																																
Balboa Heights	118	7	97	29.73	29.85	.00	80.8	+0.9	92	15	90	70	13	72	21	73	72	86	0.01	-0.9	1	8,148	nw.	30	n.	23	10	21	0	4.1	0.0	0.0
Colon	38	7	97	29.84	29.87	.00	81.6	+1.5	87	1	86	75	10	77	11	75	73	81	0.70	-2.0	18	10,968	n.	28	n.	1	7	24	0	4.7	0.0	0.0
Alaska																																
Juneau	80	11	54	----	----	----	39.6	----	50	7	43	26	20	36	13	38	36	85	11.62	----	24	6,526	s.	32	se.	7	1	1	29	9.5	6.8	0.0
Hawaiian Islands																																
Honolulu	38	86	100	----	----	----	72.8	----	80	5	78	63	25	68	13	65	62	72	0.49	-3.3	12	5,904	e.	33	ne.	21	12	17	2	4.2	0.0	0.0

TABLE 2.—Data furnished by the Canadian Meteorological Service, January, 1926

Stations	Altitude above mean sea level, Jan. 1, 1919	Pressure			Temperature of the air						Precipitation		
		Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max.+mean min.÷2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
	Feet	In.	In.	In.	°F.	°F.	°F.	°F.	°F.	°F.	In.	In.	In.
St. Johns, N. F	125												
Sydney, C. B. I	48												
Halifax, N. S	88												
Yarmouth, N. S	65												
Charlottetown, P. E. I	38												
Chatham, N. B	28												
Father Point, Que	20	29.84	29.87	−.11	8.0	0.0	16.7	−0.6	38	−19	0.87	−1.98	8.7
Quebec, Que	296	29.59	29.93	−.09	11.4	+2.3	18.1	4.7	38	−19	2.28	−1.73	19.2
Montreal, Que	187	29.71	29.94	−.10	15.0	+3.3	22.2	7.8	39	−19	1.94	−1.79	18.2
Stonecliffe, Ont	489												
Ottawa, Ont	236	29.70	29.98	−.05	14.5	+4.9	22.7	6.3	38	−23	1.97	−1.02	10.5
Kingston, Ont	285	29.63	29.97	−.08	21.7	+4.6	28.6	14.8	40	−16	1.62	−1.83	7.2
Toronto, Ont	379	29.54	29.97	−.08	24.7	+3.3	30.8	18.7	46	−5	2.27	−0.65	17.5
Cochrane, Ont	930												
White River, Ont	1,244	28.48	29.86	−.15	4.5	+4.9	17.0	−8.0	35	−42	0.96	−0.73	9.5
Port Stanley, Ont	592												
Southampton, Ont	656	29.20			22.0	+1.6	27.5	16.4	42	−7	2.65	−1.40	21.3
Parry Sound, Ont	688	29.19	29.92	−.09	17.3	+3.5	24.9	9.7	36	−25	2.16	−1.92	19.6
Port Arthur, Ont	644												
Winnipeg, Man	760												
Minnedosa, Man	1,690												
Le Pas, Man	860												
Qu'Appelle, Sask	2,115	27.63	29.97	−.11	14.4	+18.2	22.9	6.0	45	−20	0.64	+0.14	6.4
Medicine Hat, Alb	2,144	27.65	29.97	−.10	24.6	+19.1	33.9	15.3	45	−12	0.62	+0.05	5.1
Moose Jaw, Sask	1,759												
Swift Current, Sask	2,392	27.43	30.07	−.02	19.4	+16.3	28.1	10.7	40	−16	1.10	+0.46	10.9
Calgary, Alb	3,428												
Banff, Alb	4,521	25.37	30.14	+.14	19.8	+7.7	26.9	12.8	36	−6	0.32	−0.87	3.2
Edmonton, Alb	2,150	27.59	29.95	−.08	20.6	+18.8	28.3	12.8	48	−17	0.64	−0.04	6.3
Prince Albert, Sask	1,450	28.39	30.04	−.05	11.6	+20.0	21.7	1.6	55	−30	0.20	−0.77	2.0
Battleford, Sask	1,592	28.19	30.00	−.08	15.5	+21.4	24.8	6.1	44	−20	0.24	−0.16	2.4
Kamloops, B. C	1,262												
Victoria, B. C	230	29.88	30.14	+.17	42.3	+3.6	45.2	39.4	52	34	3.52	−1.87	0.0
Barkerville, B. C	4,180												
Triangle Island, B. C	680												
Prince Rupert, B. C	170												
Hamilton, Ber	151	30.02	30.19	+.06	62.8	+0.8	69.0	56.6	73	50	2.66	−2.28	0.0

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St. Johns, N. F	125	29.39	29.53	−.30	28.4	−0.3	32.9	23.9	48	15	7.61	+2.58	14.0
Winnipeg, Man	760	29.26	30.14	+.12	9.6	+5.5	15.5	3.7	43	−20	0.64	−0.27	6.0

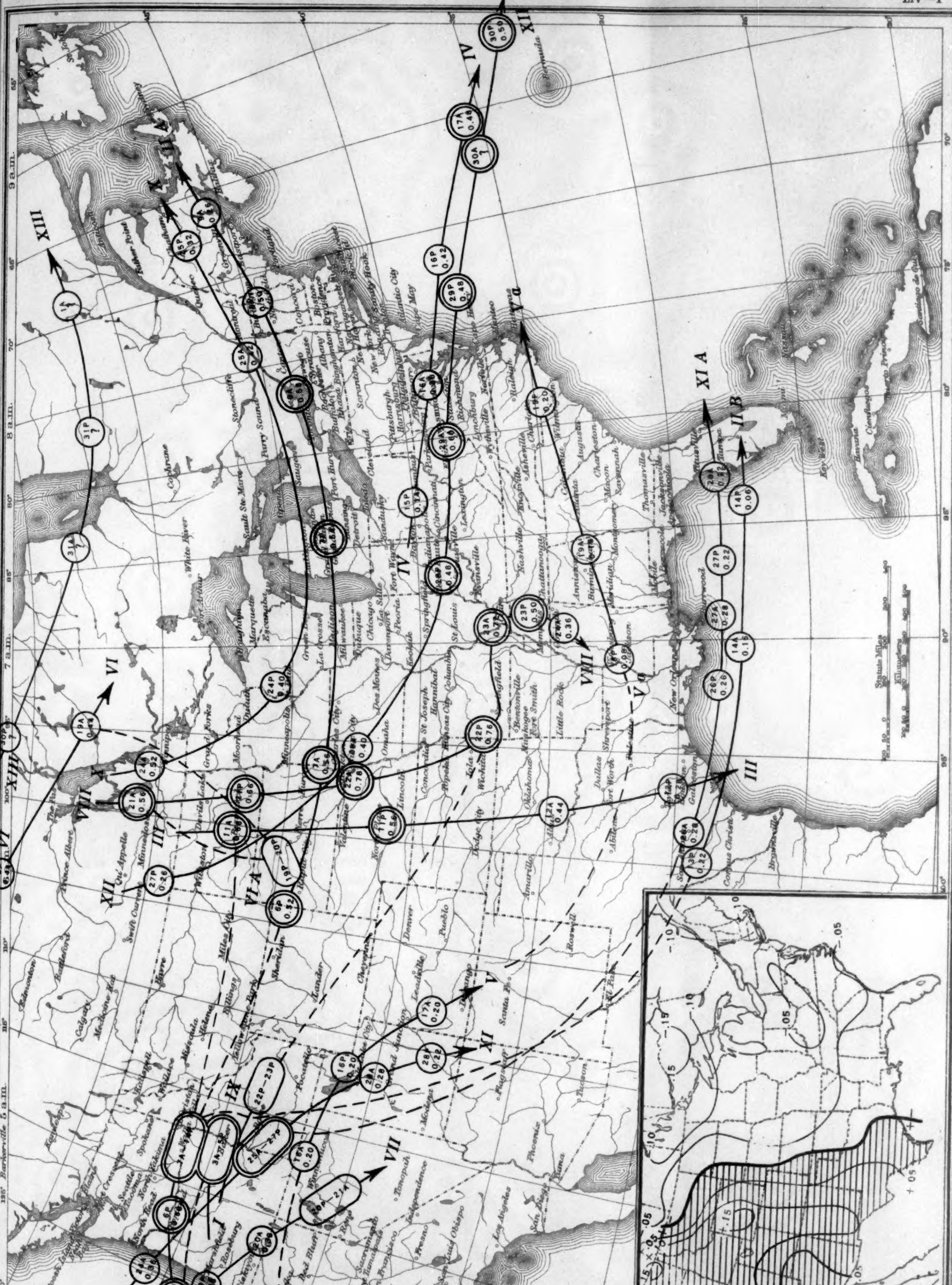

4 a.m.
Barkerville 5 a.m.
7 a.m.
8 a.m.
9 a.m.
Statute Miles
Kilometers
Bermuda
XIII
VI
XII
XI
VII
II
IV
XI A
II B
V a
VIII
III
IX
VI A

Chart II. Tracks of Centers of Cyclones, January, 1926. (Inset) Change in Mean Pressure from Preceding Month
(Plotted by Wilfred P. Day)

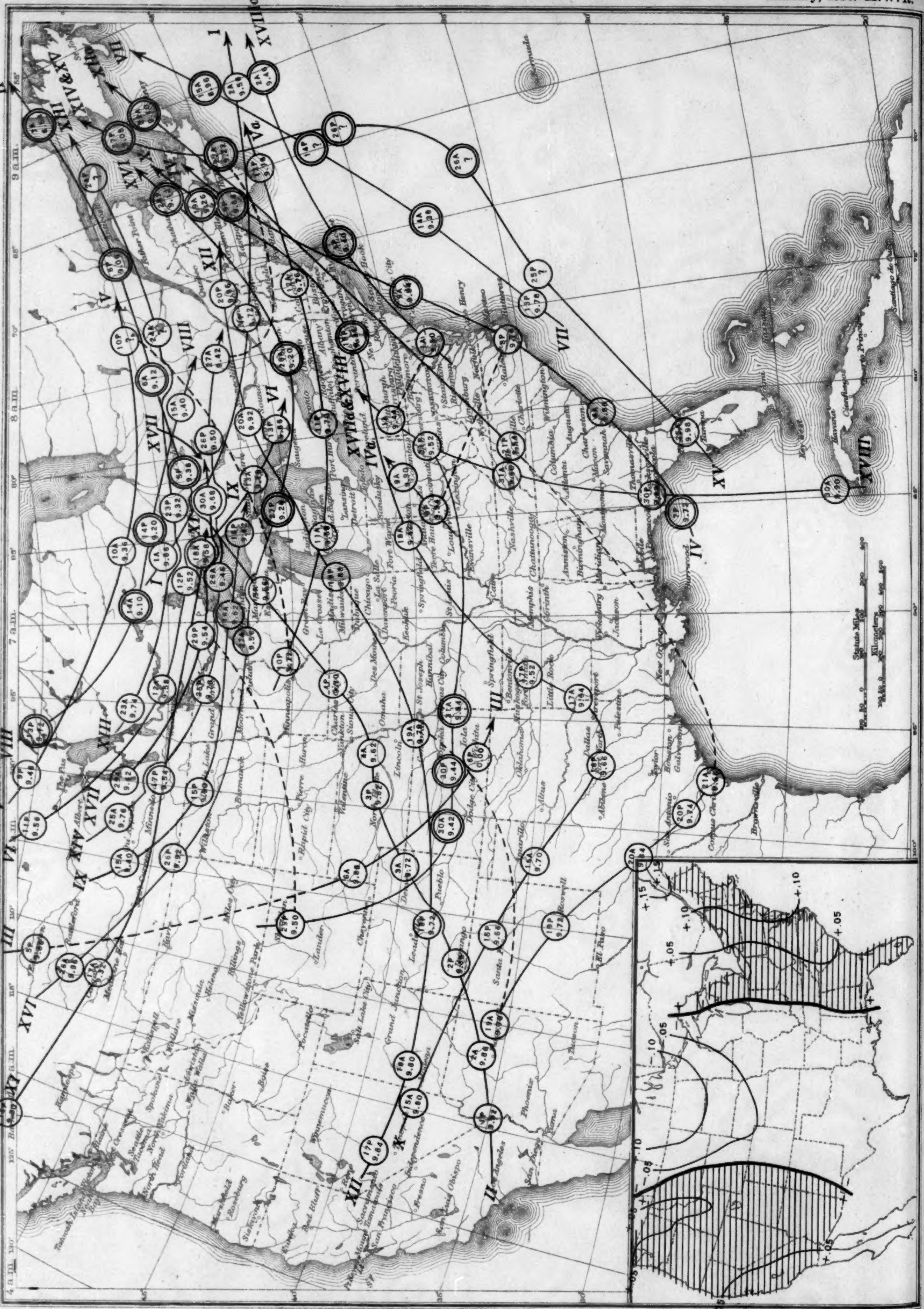


Chart III. Departure (°F.) of the Mean Temperature from the Normal, January, 1926

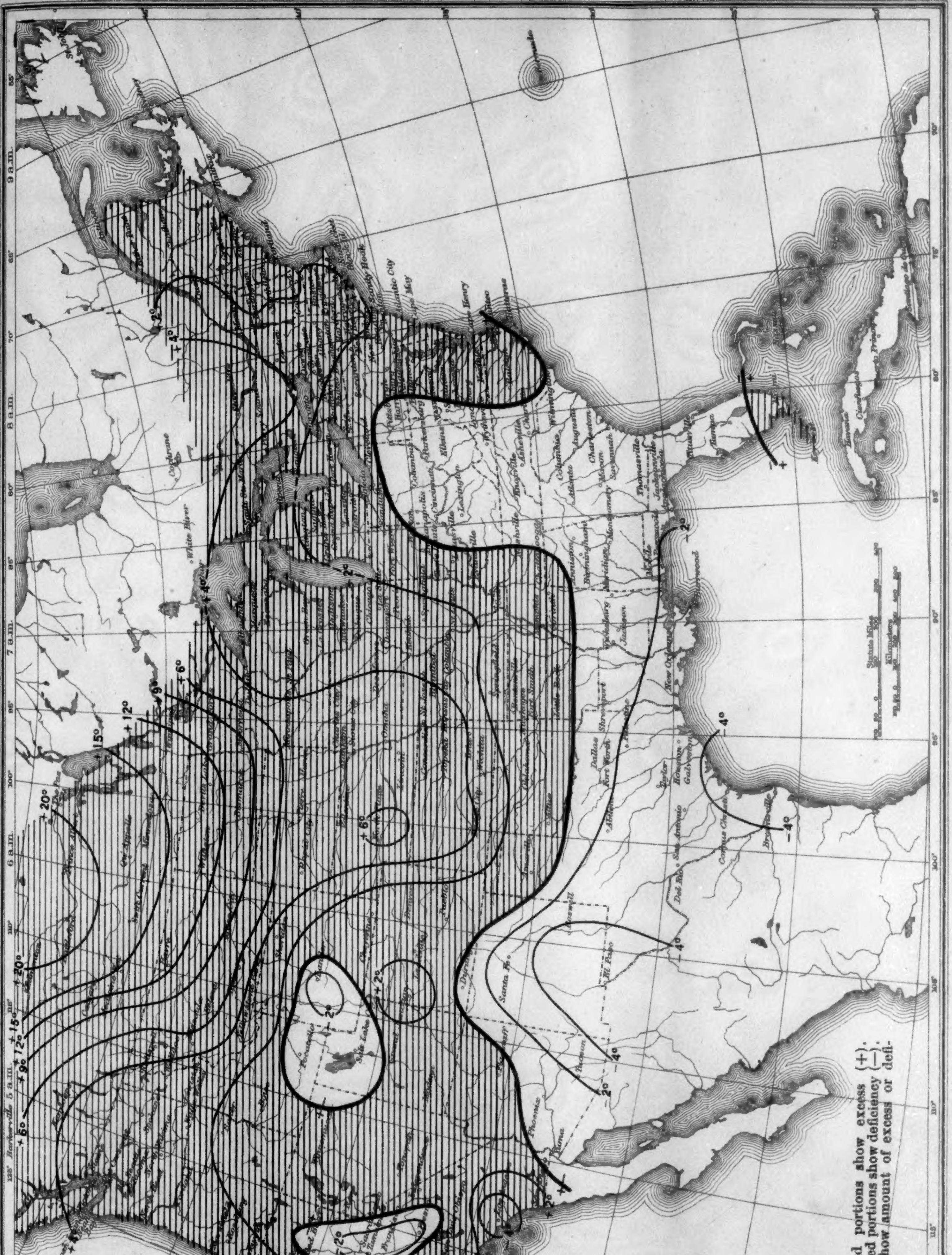


Chart III. Departure (°F.) of the Mean Temperature from the Normal, January, 1926

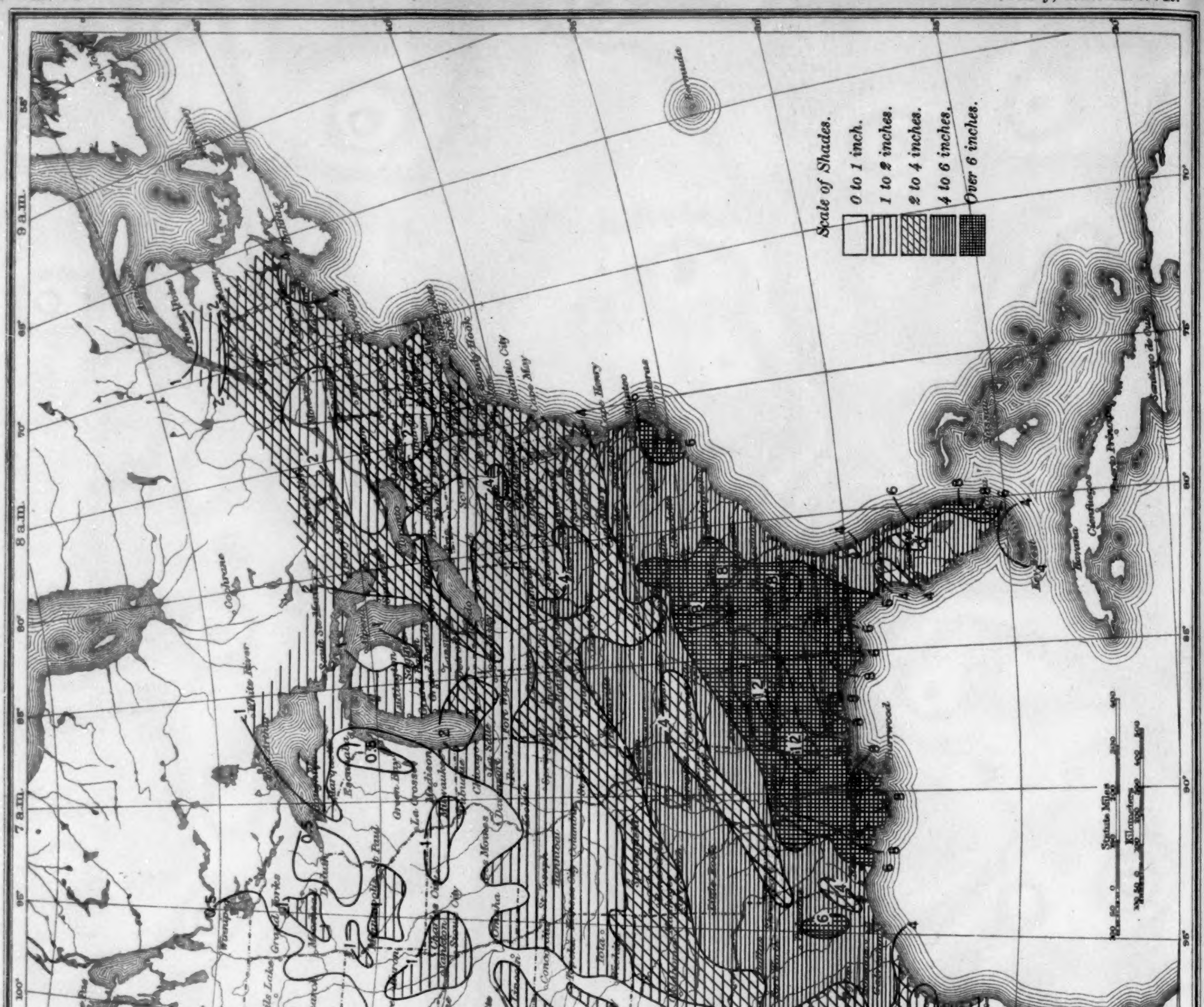


Chart IV. Total Precipitation, Inches, January, 1926. (Inset) Departure of Precipitation from Normal

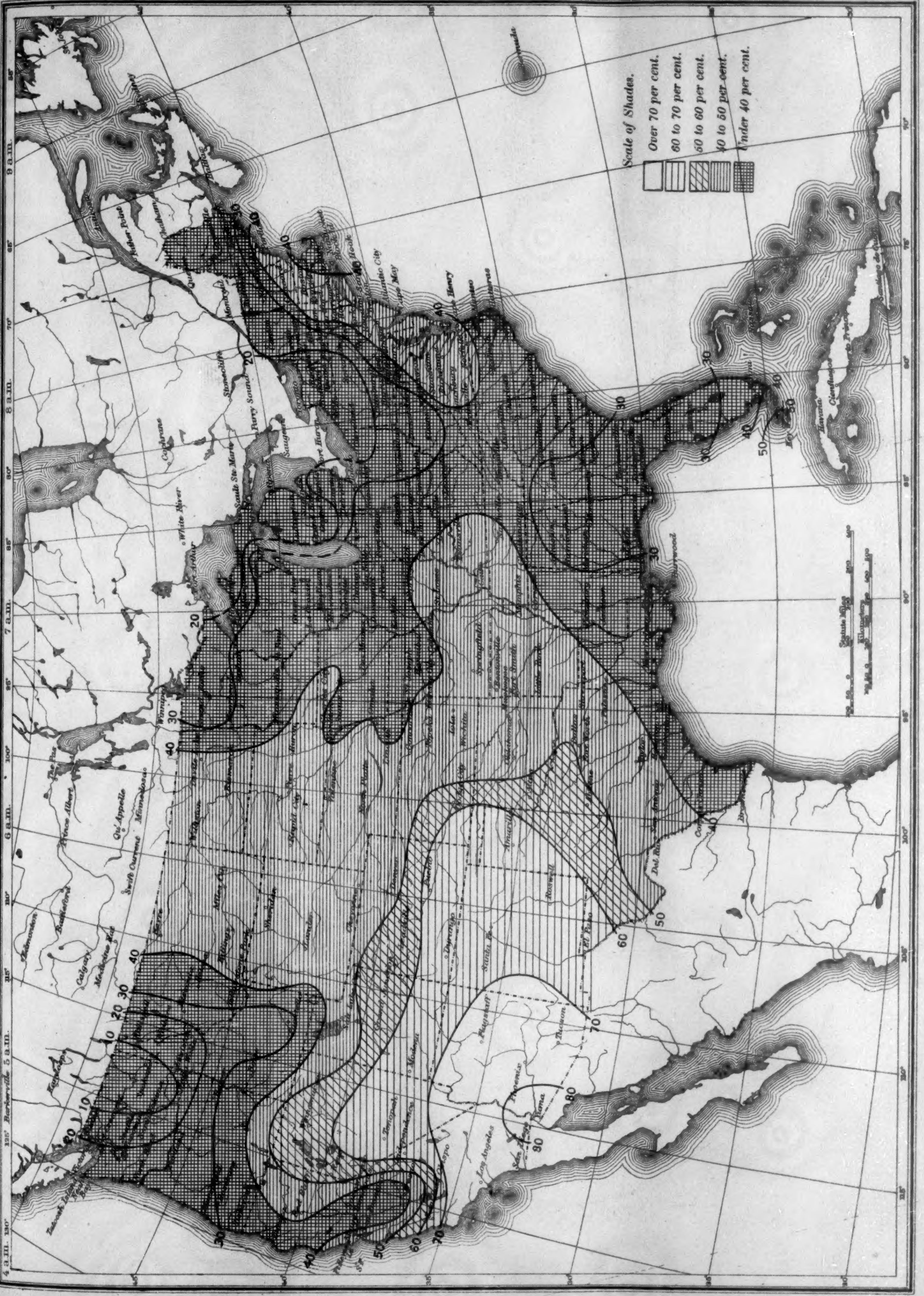


Chart V. Percentage of Clear Sky between Sunrise and Sunset, January, 1926

Chart VI. Isobars at Sea level and Isotherms at Surface; Prevailing Winds, January, 1926

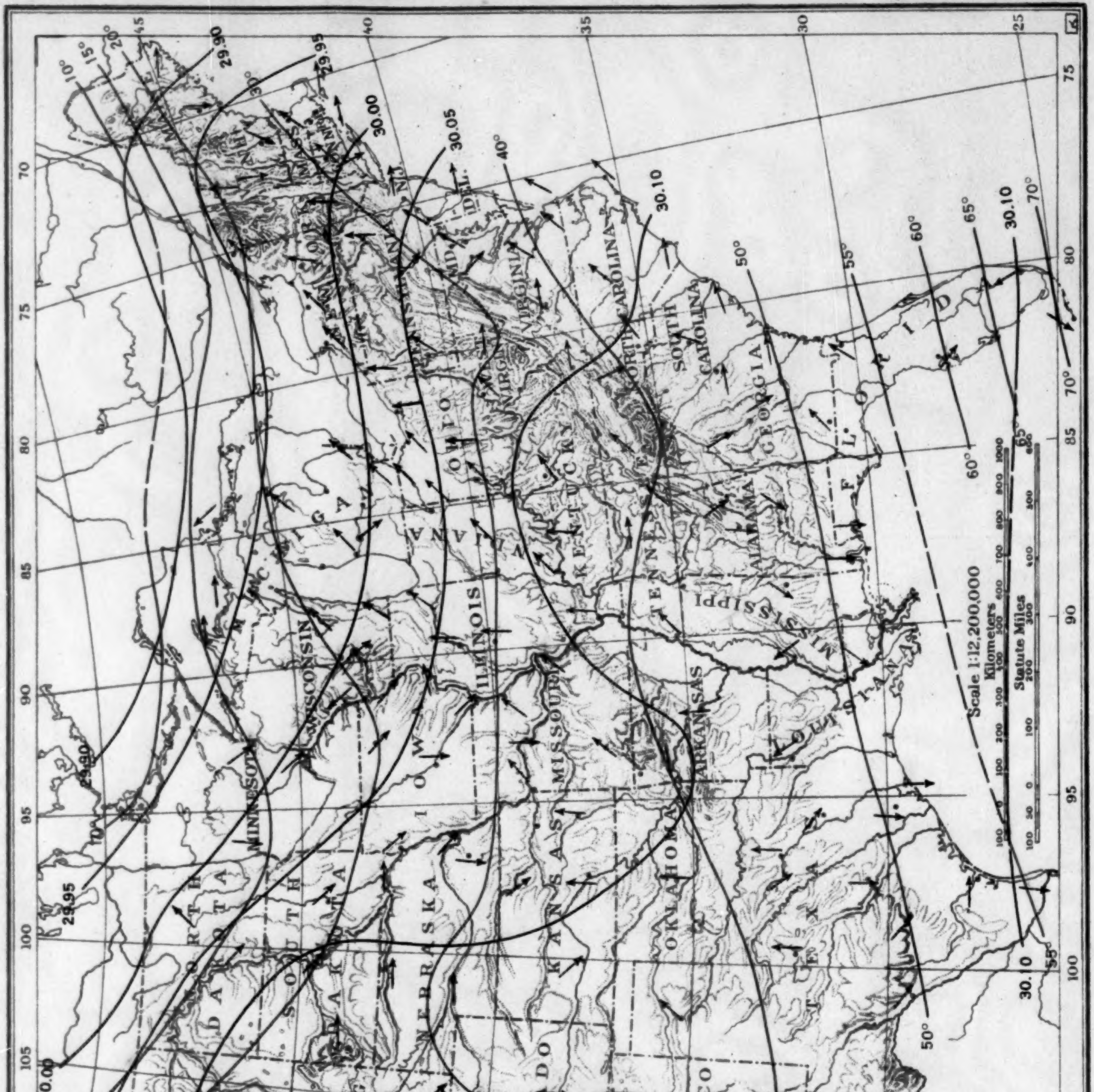
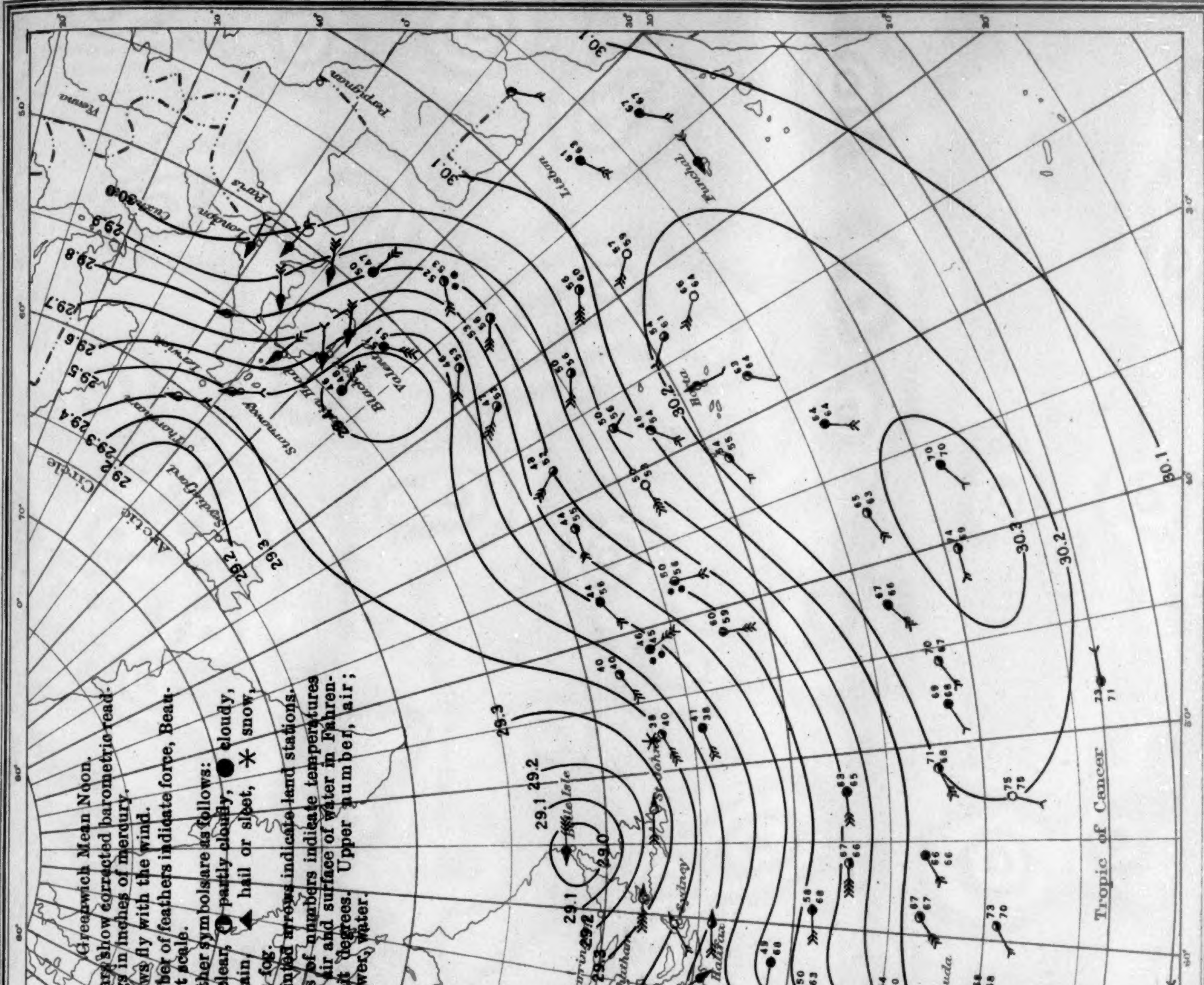


Chart VII. Total Snowfall, Inches, January, 1926. (Inset) Depth of Snow on Ground at end of Month



(Plotted by F. A. Young)

Chart IX. Weather Map of North Atlantic Ocean, January 29, 1926
(Plotted by F. A. Young)

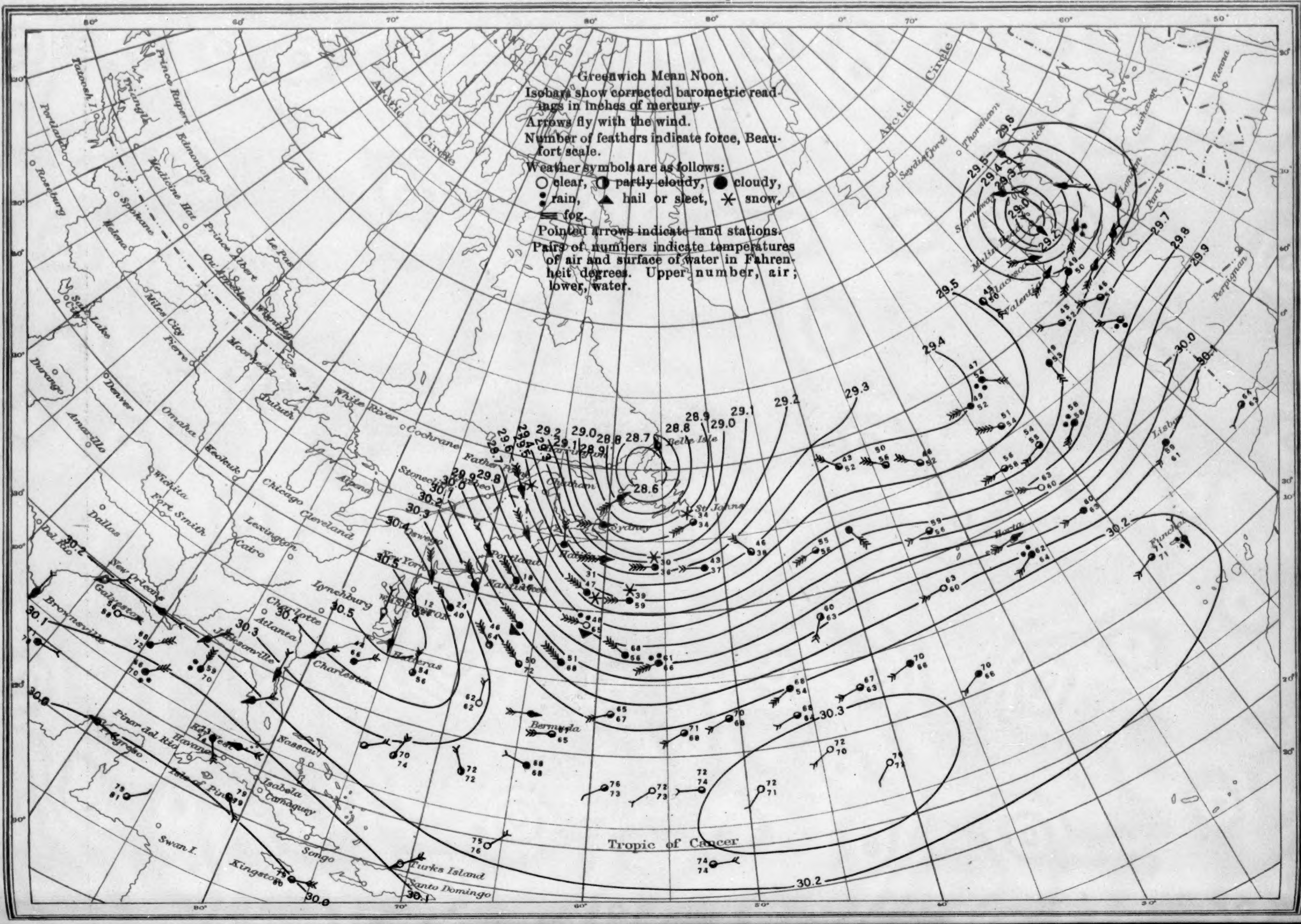


Chart X. Weather Map of North Atlantic Ocean, January 30, 1926

Chart X. Weather Map of North Atlantic Ocean, January 30, 1926
(Plotted by F. A. Young)

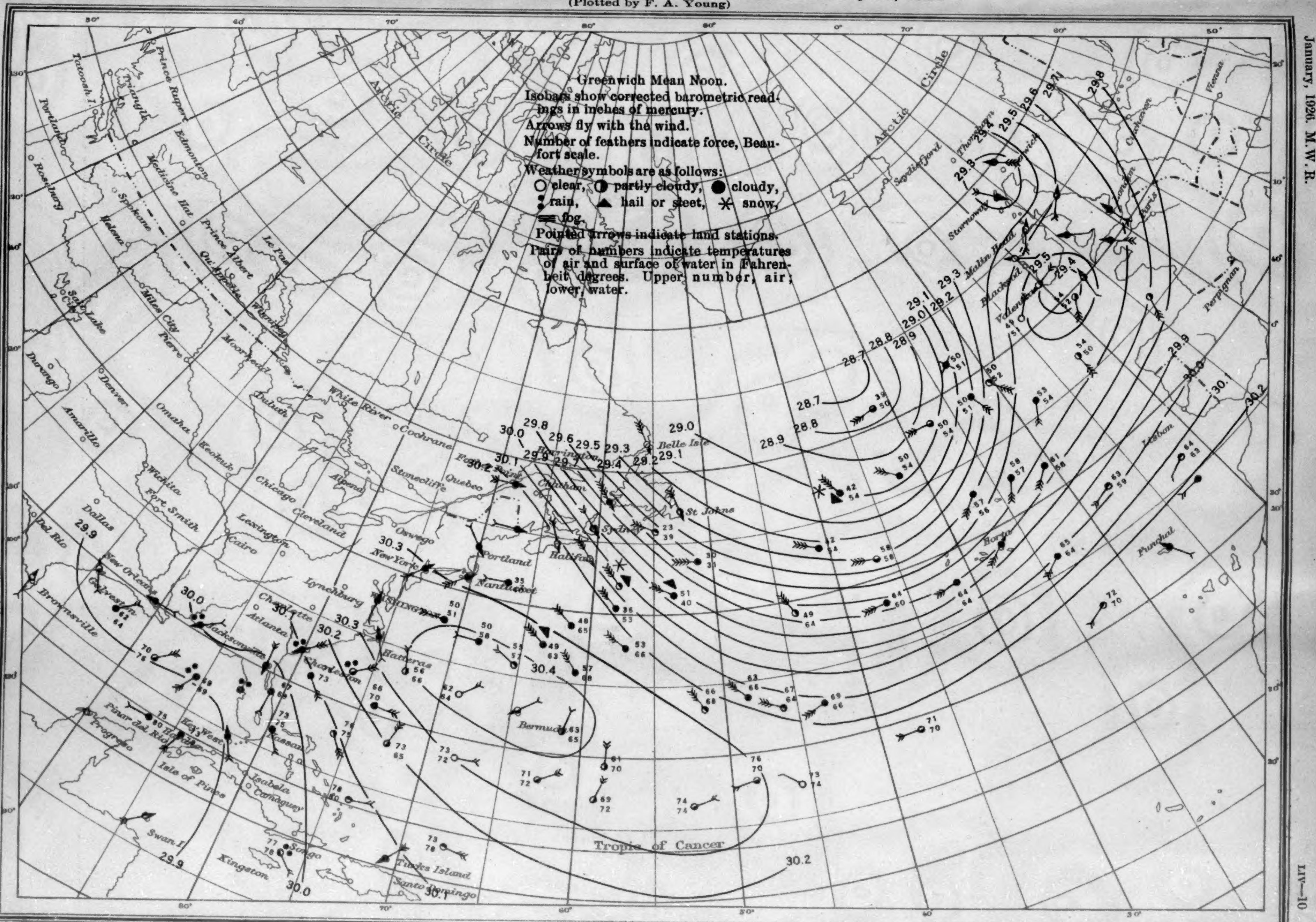


Chart XI. Weather Map of North Atlantic Ocean, January 31, 1926
(Plotted by F. A. Young)